DTCC Office of the President

Project Manual
Bid Package C

EDiS Company, Inc.

Becker Morgan Group, Inc.

Delaware Technical Community College

6 May 2013

Division 0 - Procurement and Contract Requirements

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SECTION 001113 ADVERTISEMENT FOR BID

Public notice is hereby given that sealed bids for the following prime contracts will be received for the construction and renovation of Delaware Technical Community College – Office of the President located in Dover, Delaware. Bids will be received at EDiS Company 110 S. Poplar Street Wilmington, DE 19801 (4th Floor Receptionist Desk), until 2:00 pm local time on 11 June 2013, at which time they will be publicly opened and read aloud. Bidder bears the risk of late delivery. Any bids received after the stated time will be returned unopened. The time and location of the bid opening may be extended with a minimum of 2 calendar days notice to the Bidders.

Contract	C-01	Fire Protection
Contract	C-02	Automatic Temperature Controls

Documents may be viewed and downloaded at the following FTP site:

bids.ediscompany.com
Log in: dtcca
Password: edis1313

It is the responsibility of each bidder to review and coordinate all project documents. This includes plans, specifications and addendums. Please email Mark Grunza at mgrunza@ediscompany.com if you obtain documents via the FTP site so that we can provide addenda and other information to your company. Documents may be examined at the office of the Construction Manager, EDiS Company, 110 S. Poplar Street, Suite 400, Wilmington, Delaware 19801; the office of Delaware Contractors Association, 527 Christiana Stanton Road, Newark, Delaware 19713; and F. W. Dodge Corporation, Conshohocken, Pennsylvania.

A bid security in the amount of 10% of the bid, plus consent of surety must accompany each bid. Bid Security shall specify the Owner as the obligee. Owner: Delaware Technical Community College

A Pre-Bid Meeting will be held at 2:00 p.m. local time on 23 May 2013. All attendees shall meet at EDiS Company 110 S. Poplar Street Wilmington, DE 19801. Attendance is highly suggested but not mandatory.

Please contact EDiS Company, Mark Grunza at mgrunza@ediscompany.com with questions. It is requested that all questions be issued in writing.

END OF SECTION

SECTION 002113 - INSTRUCTIONS TO BIDDERS

1. DEFINITIONS

1.1 Bidding Documents include the Contract Documents, Invitation to Bid, Instructions to Bidders, the Proposal Forms, Contract, General Conditions of the Contract, Supplementary Conditions, Specifications, Plans, and any Addenda issued prior to receipt of bids.

1.2 All definitions set forth in the General Conditions and the other Contract Documents are applicable to the Bidding Documents.

1.3 "Addenda" are written or graphic instruments issued by the Architect/Engineer prior to the receipt of bids which modify or interpret the Bidding Documents, by additions, deletions, clarifications or corrections. Addenda become part of the contract documents upon execution of the agreement.

1.4 The term Work is defined in 1.1.3 of the General Conditions.

1.5 A "Unit of Work" includes all Work covered by the one or more Sections of the specifications listed under that particular Unit of Work in Section 011100 - SUMMARY OF WORK. A Unit of Work is the smallest portion of the Project for which a separate Bid will be accepted by the Construction Manager. The word "Unit" means "Unit of Work" whenever the context clearly implies "Unit of Work".

1.6 A "Bid" is a complete and properly signed proposal to do one or more Units of Work for the sum stipulated therein.

1.7 A "Bidder" is one who submits a Bid to the Bidding Agency for the Unit or Units of Work indicated therein.

1.8 A substantial amount of specification language constitutes definitions for terms found in other Contract Documents, including drawings, which must be recognized as diagrammatic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article. Definitions and explanations to this section are not necessarily either complete or exclusive, but are general for the work to the extent not stated more explicitly in another provision of Contract Documents.

1.9 General Requirements (or Conditions) apply to entire work of Contract and, where so indicated, to other elements which are included in the project.

1.10 The term "indicated" is a cross reference to details, notes or schedules on the Drawings, to other similar means of recording requirements in the Contract Documents. Where terms such as "shown", "noted", "schedule" and "specified" are

used in lieu of "indicate," it is for purpose of helping to locate cross reference and no limitation of location is intended, except as specifically noted.

1.11 Where not otherwise explained, terms such as "directed", "requested", "authorized", "selected", "approved", "required", "accepted" and "permitted" mean "directed by Construction Manager or Architect", "requested by Construction Manager or Architect", etc.

1.12 Where used in conjunction with Construction Manager's or Architect's response to submittals, requests, applications, inquiries, reports and claims by Contractor, the meaning of the term "approved" will be held to limitations of Construction Manager's and Architect's responsibilities and duties as specified in General and Supplementary Conditions. In no case will "approval" by Construction Manager or Architect be interpreted as a release of Contractor from responsibilities to fulfill requirements of the Contract Documents.

1.13 The "Project Site" is the space available to Contractor for performance of the Work, either exclusively or in conjunction with others performing other work as part of the Project. The extent of project site is shown on the Drawings and may or may not be identical with description of the land upon which project is to be built. The Contractor shall visit the site to verify contract or construction limits.

1.14 Except as otherwise defined in greater detail, term "furnish" is used to mean supply and deliver to project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

1.15 Except as otherwise defined in greater detail, term "install" is used to describe operations at project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations as applicable in each instance.

1.16 Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.

1.17 An "Installer" is the entity, person or firm, engaged by the Contractor or his subcontractor or sub-subcontractor for the performance of a particular unit of work at the project site, including installation, erection, application and similar required operation. It is a general requirement that such installers be expert in operations they are engaged to perform.

1.18 The duties and obligations of the Contract apply to this Contractor (as defined herein) regardless of similar or identical duties or obligations of other Prime Contractors related to the Project. Therefore, even though other Prime Contractors may have similar, identical or overlapping duties and obligations, each and every duty and obligation set forth in this Contract is enforceable against this Contractor.

2. BIDDER'S REPRESENTATION

2.1 Each Bidder in submitting its bid represents that:

1. It has read and understands the Bidding Documents and its Bid is made in accordance therewith.

2. Contractor has visited the site; familiarized himself with the local conditions under which the work is to be performed; compared the site with drawings and specifications; satisfied himself of the conditions of delivery, handling and storage of materials and all other matters that may be incidental to the Work before submitting his Bid.

3. Its Bid is based upon the materials and equipment described within the Bidding Documents without exceptions.

2.2 EVIDENCE OF REPRESENTATION

1. Submission of a Bid will be considered as evidence of the bidder's representation. No allowance will subsequently be made to the successful contractor by reason of any error omission on his part, due to his neglect in complying with the requirements of this article.

3. BIDDING DOCUMENTS

3.1 ISSUANCE

1. The drawings and specifications of preceding bid packages may not be issued with the drawings and specifications of this bid package. Bid Pac A was only issued for Modular Units for relocation of existing employees. No information from Bid Pac "A" is needed for bidding Bid Pac "B". Contractors bidding on work in this bid package are responsible for knowing what work has preceded this bid package and how it affects its work. In order to assist contractors in this effort, the contract documents from preceding or simultaneous bid packages will be available for review at the Construction Manager's main office and job site office. Bidding documents will be made available to qualified bidders only. Contractors are advised that no change orders will be allowed that are based on ignorance of work assigned in preceding or simultaneous bid packages.

2. Bidding Documents will not be issued to subcontractors or other individuals or organizations who will not be contracting directly with the Owner.

3. The complete set of Bidding Documents shall be used in preparing bids; neither the Owner, the Architect nor the Construction Manager assume any

responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

4. The Owner, Architect, and the Construction Manager, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining bids on the Work and do not confer a license or grant for any other use.

3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

1. Bidders shall examine the Bidding Documents carefully and shall promptly notify the Construction Manager of any ambiguity, inconsistency or error which they may discover. No request for adjustment of Contract Time or Sum shall be permitted with regard to any purported ambiguity, inconsistency or error not promptly noticed to the Construction Manager.

2. Bidders requiring clarification or interpretation of the Bidding Documents shall make a written request to the Construction Manager to reach him at least seven days prior to the date of receipt of bids.

3. Any interpretation, correction or change of the Bidding Documents will be made by Addendum. Interpretations, corrections, or changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon such interpretations, corrections, and changes.

3.3 SUBSTITUTIONS

1. Refer to Specification Section 016200 - MATERIAL AND EQUIPMENT.

2. Substitution requests must be made at least seven (7) days prior to the receipt of bids.

3.4 ADDENDA

1. Addenda will be emailed, mailed, faxed or delivered to each person or firm recorded by the Construction Manager as having received a complete set of the Bidding Documents, and will be available for inspection wherever the Bidding Documents are kept available for that purpose.

2. Sub-Bidders, Suppliers, Manufacturers and others wishing to have Addenda mailed free of charge directly to them should address a letter to the Construction Manager requesting a listing on the Addenda mailing list for this Project. Such letter must include no other subject matter, must clearly identify this Project by name, and must indicate, line for line, exactly how the name and address is to be typed on the envelope. Phone requests will not be accepted.

The Construction Manager will endeavor, but expressly does not promise, to mail Addenda directly to those who have properly requested. Such mailing list is for this one Project only.

3. Addenda issued during the time of bidding shall be listed on Bid form in the space provided. Failure of a Bidder to receive any Addendum shall not release the Bidder from any obligations under his Bid, provided said addendum was sent by fax or by U.S. Mail to the address furnished by the bidder for transmittal of mail. Faxed Addenda will be confirmed by U. S. Mail.

4. No Addenda will be issued later than three (3) days prior to the date for receipt of Bids, except an Addendum withdrawing the request for Bids or one which extends the time or changes the location for the opening of Bids.

4. BIDDING PROCEDURE

4.1 FORM AND STYLE OF BIDS

1. Bids shall be submitted in triplicate upon the proposal form included in these specifications, or upon an exact copy of it.

2. The Bidder shall complete all blank spaces on the Bid form.

3. Where indicated on the Bid form, sums shall be expressed in both words and figures. In case of discrepancy between the two, the written amount shall govern.

4. Any interlineation, alteration or erasure of an entry made in a blank space of the form must be initialed by the signer of the Bid. However, no interlineation, alteration or erasure shall be made in the wording printed on the bid form unless the Bidder is instructed by the Bidding Documents to do so. The Bidders shall add no stipulations or qualifications on the Bid form or accompanying the bid form unless permitted by or instructed by the Bidding Documents to do so.

5. All requested quantities, unit prices and alternates shall be included as part of the bid.

6. All signatures shall be in long hand.

7. The Bidder shall include on the Bid Form, within the Base Bid total costs associated with providing both the Labor and Material Payment and Performance Bonds.

8. The Bidder shall affix his seal to the bid form, if organized as a corporation.

4.2 SUBMISSION OF BIDS

1. Bids shall be deposited at the designated location prior to the time and date for receipt of Bids indicated in the Invitation to Bid, or any extension thereof made by Addendum. The time and location of the bid opening may be extended with a minimum of two (2) calendar days notice to the Bidders. Bids received after the time and date for receipt of Bids will be marked "LATE BID" and returned.

2. The Bid Proposal (3 copies) shall be enclosed in a sealed envelope. The envelope shall be addressed to the Owner, and shall be identified with the Project name, the Bidder's name and address and the Unit of Work included in the Bid.

3. If the Bidder submits his Bid by mail, he shall enclose the above described sealed envelope in a separate mailing envelope with the notation "BID ENCLOSED' on the face thereof.

4. Bids shall include a fully executed Bid Bond, Power of Attorney, Non-collusion Statement, Consent of Surety and Subcontractor listing.

4.3 MODIFICATION OR WITHDRAWAL OF BID

1. A Bidder may modify his Bid in writing at any time prior to the time scheduled for receiving Bids, provided such written modification is received by the Construction Manager prior to said time.

2. Unless specifically authorized, faxed bids will not be considered.

3. No Bidder shall modify, withdraw or cancel his Bid or any part thereof for NINETY (90) days after the time designed for the receipt of Bids, in the Invitation to Bid. Any further extension of the time will be by mutual consent of the Owner and the Contractor.

4. A Bid may be withdrawn up until the time scheduled for receiving the Bids. Such withdrawal shall be in writing.

5. CONSIDERATIONS OF BIDS

5.1 OPENING OF BIDS

1. Bid shall be publicly opened and read aloud.

5.2 REJECTION OF BIDS

1. The Owner, in its sole discretion, shall have the right to reject any or all bids for any reason or for no reason whatsoever.

5.3 ACCEPTANCE OF BIDS

1. The Owner, in its sole discretion, shall have the right to waive any informality or irregularity in any Bid received.

2. The Owner shall have the right to accept Alternates in any order or combination.

6. SUBCONTRACT INFORMATION

6.1 SUBMISSION OF SUBCONTRACTOR LIST

1. Should the Contractor fail to utilize any or all of the Subcontractors in the Contractor's Bid statement in the performance of the Work on the public bidding, the Contractor shall be penalized in the amount of (project specific amount *). The Agency may determine to deduct payment of the penalty from the Contractor or have the amount paid directly to the Agency. Any penalty amount assessed against the Contractor may be remitted or refunded, in whole or in part, by the Agency awarding the Contract, only if it is established to the satisfaction of the Agency that the Subcontractor in question has defaulted or is no longer engaged in such business. No claim for the remission or refund of any penalty shall be granted unless an application is filed within one year after the liability of the successful Bidder accrues. All penalty amounts assessed and not refunded or remitted to the Contractor shall be reverted to the State.

   * one (1) percent of the contract amount not to exceed $10,000.

2. Upon request of the Construction Manager, the Bidder shall within seven (7) days of the request submit a list of the other subcontractors or other persons or organizations (including those who are to furnish materials or equipment fabricated to a special design) if any, proposed for the various portions of the Work not included in the subcontractors list submitted with the bid.

3. The Bidder will be required to establish to the satisfaction of the Construction Manager the capability and experience of all proposed subcontractors to furnish and perform the work described in the sections of the specifications pertaining to such proposed subcontractor's respective trades.

4. Subcontractors and other persons and organizations proposed by the Bidder and accepted by the Owner must be used on the work for which they were proposed and accepted, and shall not be changed except with the written approval of the Construction Manager.

7. EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

During the performance of this Contract, the Contractor agrees as follows:

7.1 The Contractor will not discriminate against any employee or applicant for employment because of race, creed, color, sex or national origin. The Contractor will take affirmative action to ensure the applicants are employed, and that employees are treated during employment, without regard to their race, creed, color, sex or national origin. Such action shall include, but not be limited to, the following: Employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training including apprenticeship. The Contractor agrees to post in conspicuous places available to employees and applicants for employment notices to be provided by the contracting agency setting forth this nondiscrimination clause.

7.2 The Contractor will, in all solicitants or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, color sex, or national origin.

7.3 The term "Contract for public works" means construction, reconstruction, demolition, alteration and repair work and maintenance work paid for, in whole or in part, with public funds.

7.4 The Secretary of the Department of Labor shall be responsible for the administration of this section and shall adopt such rules and regulations and issue such orders as he deems necessary to achieve the purpose thereof, provided that no requirement established herby shall be in conflict with subchapter 6904 of this title.

8. PREVAILING WAGE REQUIREMENT

8.1 Wage Provisions: In accordance with Delaware Code, Title 29, Section 6960, renovation projects whose total cost shall exceed $15,000 and $100,000 for new construction, the minimum wage rates for various classes of laborers and mechanics shall be as determined by the Department of Labor, Division of Industrial Affairs of the State of Delaware.

8.2 The prevailing wage shall be the wage paid to a majority of employees performing similar work as reported in the Department's annual prevailing wage survey or in the absence of a majority, the average paid to all employees reported.

8.3 The Contractor shall pay all mechanics and labors employed directly upon the site of work, unconditionally and not less often than once a week and without subsequent deduction or rebate on any account the full amounts accrued at time of payment, computed at wage rates not less than those stated in the specifications, regardless of any contractual relationship which may be alleged to exist between the employer and such laborers and mechanics.

8.4 The scale of the wages to be paid shall be posted by the employer in a prominent and easily accessible place at the site of the work.

8.5 Every contract based upon these specifications shall contain a stipulation that certified sworn payroll reports be maintained by every Contractor and Subcontractor performing work upon the site of construction. The Contractor and Subcontractor shall keep and maintain the sworn payroll information for a period of 2 years from the last day of the work week covered by the payroll. A certified copy of these payroll reports shall be made available: 1) Effective June 30, 2007, all Contractors performing work on public work projects are required to furnish sworn payroll records on a weekly basis to the Department of Labor. Specifically, 29 Del. C. § 6960(c) states that "(e)very contract… shall contain a stipulation that sworn payroll information, as required by the Department of Labor, be furnished weekly." Further, that "(t)he Department of Labor shall keep and maintain the sworn payroll information for a period of 6 months from the last day of the work week covered by the payroll." Lastly, the failure to submit payroll reports shall be subject to a civil penalty of not less than $1,000 nor more than $5,000 for each violation. 29 Del. C. § 6960(e). Sworn payroll information shall consist of a fully completed and notarized report on a form provided upon request by the Department of Labor. *See* Delaware Prevailing Wage Regulations VII A.2(c)"; 2) upon request by the public or for copies thereof. However, a request by the public must be made through the Department of Labor. The requesting party shall, prior to being provided the records, reimburse the costs of preparation by the Department of Labor in accordance with the Department's copying fee policy. The public shall not be given access to the records at the principal office of the Contractor or Subcontractor; and 3) the certified payroll records shall be on a form provided by the Department of Labor or shall contain the same information as the form provided by the Department and shall be provided within 10 days from receipt of notice requesting the records from the Department of Labor.

9. PERFORMANCE AND PAYMENT BONDS

9.1 The Contractor shall be required to furnish bonds covering the faithful performance of the contract and the payment of all obligations arising thereunder with such sureties secured through the Bidder's usual sources as may be agreeable to the parties. The Owner shall be noted as the obligee. The owner is Delaware Technical Community College.

9.2 The performance and payment bonds shall each be in an amount equal to 100% of the Contract Sum as adjusted from time to time. The Owner shall be noted as the obligee. The owner is Delaware Technical Community College.

9.3 TIME OF DELIVERY AND FORM OF BONDS

1. The Bidder shall deliver the required bonds within seven (7) days from receipt of request from the Construction Manager.

2. The performance and payment bonds shall be written in the form found in Section 00600 Bonds.

3. The required bonds shall be by an authorized agent of the bonding company and shall be accompanied by a certified and current copy of the bonding agent's Power of Attorney, indicating the monetary limit of such power. The bonding company shall be licensed to operate in the state which the work is to be performed.

10. EXECUTION OF AGREEMENT

10.1 The Agreement will be written on a contract form, stipulated by the Owner, a copy of which is included in the Specifications.

10.2 The Bidder shall, within seven (7) days following its presentation, execute the Agreement and return it to the Construction Manager.

10.3 The Bidder agrees to commence work within seven (7) days of 1) execution of the Agreement, or 2) receipt of a Letter of Intent to execute the Agreement, or other authorization to proceed, if furnished at an earlier date.

10.4 If the successful Bidder fails to execute the required Contract and Bond, as aforesaid, within twenty (20) days after the date of official Notice of the Award of the Contract, their Bid guaranty shall immediately be taken and become the property of the State for the benefit of the Agency as liquidated damages, and not as a forfeiture or as a penalty. Award will then be made to the next lowest qualified Bidder of the Work or readvertised, as the Agency may decide.

11. GENERAL COMMENTS

11.1 JOINT VENTURE AGREEMENTS

In the event of a mandatory pre-bid meeting, representatives of both Joint Ventures must attend the pre-bid meeting and must be an officer and co-joint venture of the corporations involved.

Each Joint Venture shall be qualified and capable to complete the project with their own forces.

Included with the bid submission, and as a requirement to bid, a copy of the executed Joint Venture Agreement shall be submitted and signed by all Joint Ventures involved.

All required bid bonds, performance bonds, material and labor payment bonds must be executed by both Joint Ventures and be placed in both of their names.

All required insurance certificates shall name both Joint Ventures.

Both Joint Ventures shall sign the bid form and shall submit a valid Delaware Business License Number with their bid or shall state that the process of application for a Delaware Business License has been initiated.

Both Joint Ventures shall include their Federal E. I. Number with the bid.

Due to exceptional circumstances and for good cause shown, one or more of these provisions may be waived at the discretion of the Owner.

11.2 LICENSE APPLICATION REQUIRED TO BID

A business license application must be initiated prior to or in conjunction with the submission of a bid on competitively bid contracts exceeding $50,000; or in the case of a subcontractor, prior to the submission of a bid by the general contractor. The license application procedure may be initiated by visiting or calling the Division of Revenue.

11.3 BONDING REQUIREMENTS FOR NON-RESIDENT CONTRACTORS

All non-resident contractors are reminded that they must supply a surety or cash bond to the Division of Revenue equal to six percent (6%) of the total of all contracts exceeding $20,000 for construction within this state. For Division of Revenue purposes, cash bonds and bank letters of credit issued by financial institutions will be accepted on all contracts.

11.4 CONTRACT AWARD TO NON-RESIDENT CONTRACTORS

Every architect, or professional engineer or contractor or construction manager engaging in the practice of such profession shall furnish the Department of Finance within 10 days after entering into any contract with a contractor or subcontractor not a resident of this State, a statement of the total value of such contract or contracts together with the names and addresses of the contracting parties.

11.5 STATE LICENSE AND TAX REQUIREMENTS

The Contractor and Subcontractor shall be licensed to do business in the State of Delaware and shall pay al fees and taxes due under State laws. In conformance with Section 2503, Chapter 25, Title 30, Delaware Code, "the Contractor shall furnish the State Tax Department within ten (10) days after award of the Contract, a statement of the total values of each contract and subcontract, together with the names and addresses of the contracting parties . . ."

11.6 RIGHT TO AUDIT RECORDS

The Owner (contracting agency) shall have the right to audit the books and records of a Contractor or any Subcontractor under any Contract or Subcontract to the extent that the books and records relate to the performance of the Contract or Subcontract.

Said books and records shall be maintained by the Contractor for a period of three (3) years from the date of final payment under the Prime Contract and by the Subcontractor for a period of three (3) years from the date of final payment under the Subcontract.

END OF SECTION

SECTION 003132 – GEOTECHNICAL DATA

1. GENERAL

1.1 Owner's Disclaimer

A. Site Information: Data on subsurface conditions are made available in the Bidding Documents as a convenience to Bidders and the Contractor. They are not intended as representations or warrants of continuity of such conditions between soil borings. It shall be expressly understood that the Owner will not be responsible for interpretations or conclusions drawn there from by the Contractor. The test borings that were administered by John D. Hynes & Associates, Inc. have been provided at the end of this section. The report, dated October 16, 2012 can be found in the Bid Pac "B" Project Specifications Manual.

1.2 SOIL BORING DATA

A. Boring logs are available at the end of this section. The report, completed by John D. Hynes & Associates, Inc., dated October 16, 2012 can be found in the Bid Pac "B" Project Specifications Manual.

1.3 UTILITY LOCATION DATA

B. The Contract Drawings indicate the known whereabouts of existing utilities and their proposed relocations.

JOHN D. HYNES & ASSOCIATES, INC.

Geotechnical and Environmental Consultants
Monitoring Well Installation
Construction Inspection and Materials Testing

October 16, 2012

Mr. Brad Hastings, AIA
Becker Morgan Group, Inc.
Port Exchange, Suite 300
312 West Main Street
Salisbury, Maryland 21801

Re: Report of Subsurface Exploration and Geotechnical
Supplemental Consulting Services
DelTech Administration Building Addition-
Terry Campus
Dover, Delaware
Project No.: JDH-10/12/307

Dear Mr. Hastings:

John D. Hynes & Associates, Inc. has completed the authorized subsurface exploration and geotechnical consulting services for the proposed DelTech Administration Building Addition-Terry Campus project located in Dover, Delaware. As requested, we augered an additional test boring at the site and performed a field infiltration test adjacent to the test boring.

On October 8, 2012, a Hynes & Associates driller visited the project site to perform the drilling and infiltration testing. We hand augered a test boring at location S-3 indicated on the attached "Boring Location Plan" (Drawing JDH-10/12/307-B). The boring was drilled to a depth of 10 feet. Referring to the attached boring log, note that we encountered Sandy SILTs (ML), Silty SANDs (SM) and SANDs (SP) in the test boring. These descriptions are in accordance with the Unified Soil Classification System. We did not encounter groundwater in the boring. These soils were classified as Silt Loam, Sandy Loam and Sand, respectively, in accordance with the USDA soil classification system.

Following the test boring, we hand augered a companion boring adjacent to the boring to a depth of 6 feet. We performed a field infiltration test in accordance with the falling head method approved by DNREC. A copy of the test procedures is included in the attachments. The test results are, also, attached. The test results were 9.12 in./hr. in the final test hour, and 13.38 in./hr. as the time weighted average.

Refer to the August 20, 2012 Geotechnical Report for the balance of the project data, and our geotechnical engineering recommendations.

32185 Beaver Run Drive • Salisbury, Maryland 21804 • 410-546-6462 • Fax 410-548-5346
Email: jdhynes@aol.com

We appreciate the opportunity to be of service to you. If you have any questions regarding the contents of this report or if we may be of further assistance, please contact our office.

Respectfully,
John D. Hynes & Associates, Inc.

John D. Hynes, P.E.
President

JDH/jsl

JOHN D. HYNES
REGISTERED
No. 7581
DELAWARE
PROFESSIONAL ENGINEER

32185 Beaver Run Drive • Salisbury, Maryland 21804 • 410-546-6462 • Fax 410-548-5346
Email: jdhynes@aol.com

HYNES

ATTACHMENTS

1. Project Location Map
2. Boring Location Plan
3. Boring Log
4. Infiltration Test Data Sheet
5. Infiltration Test Procedures
6. Field Classification Sheet
7. Unified Soil Classification Sheet
8. USDA Classification Sheet
9. Information Sheet

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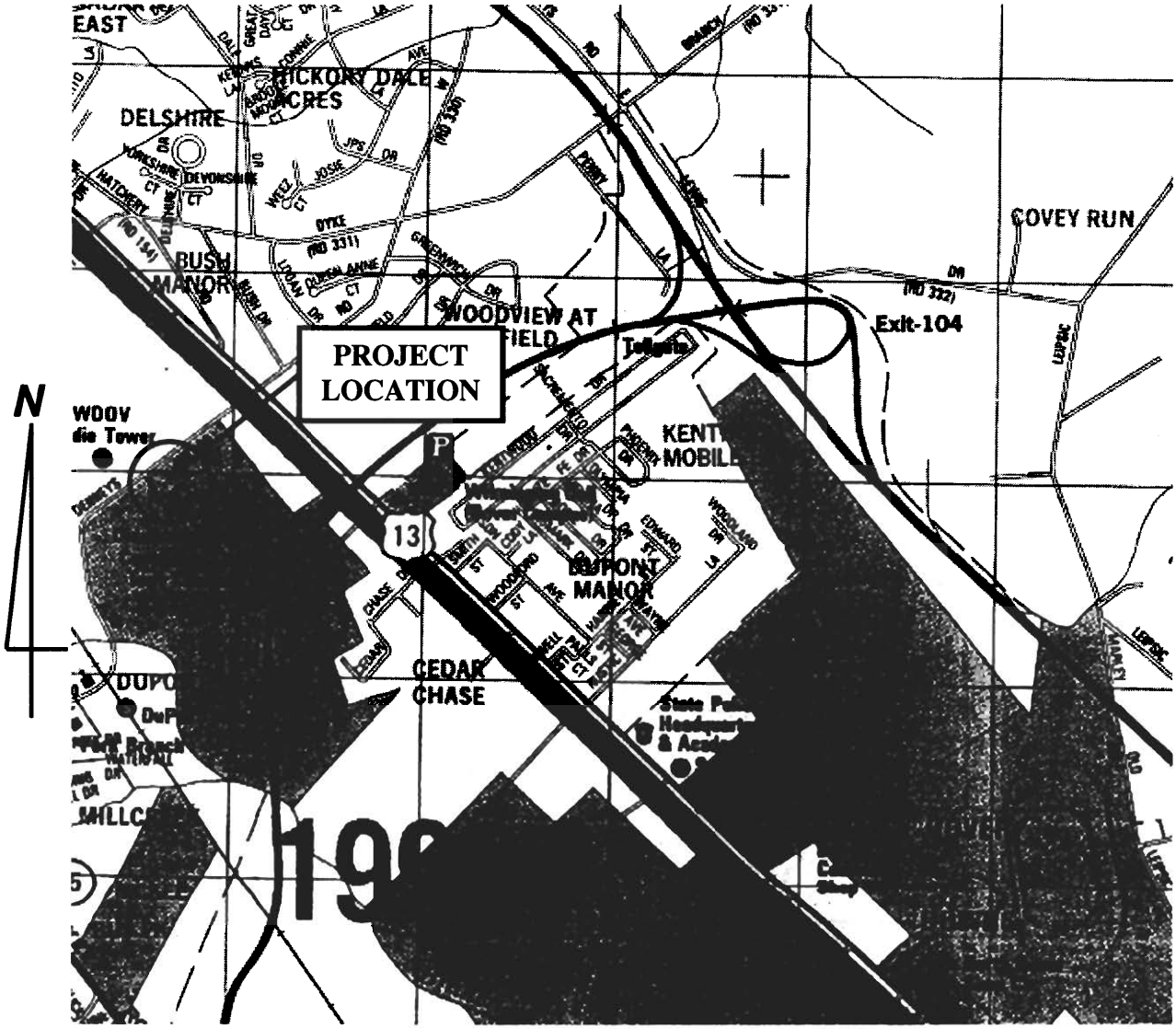
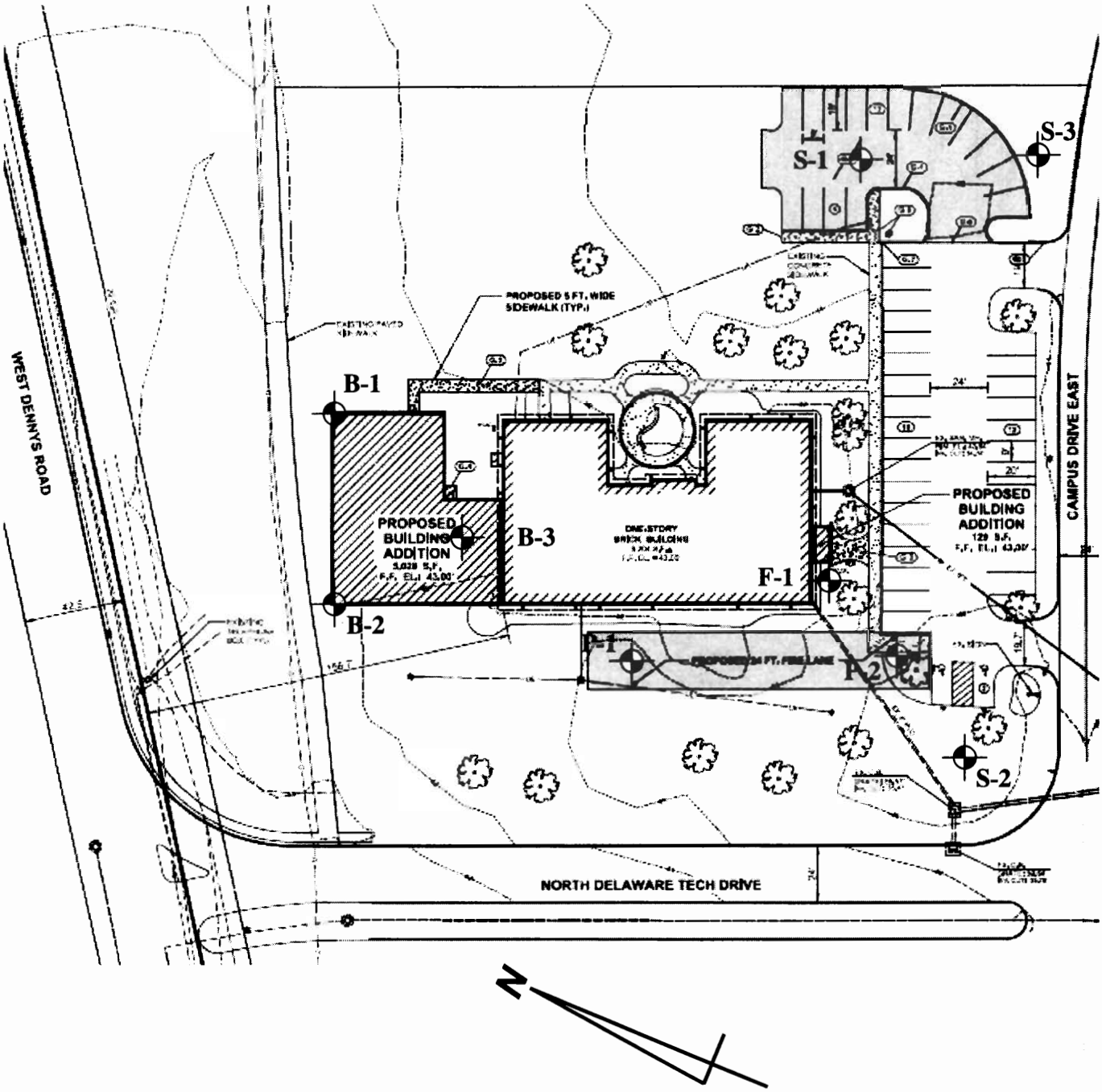
Email: jdhynes@aol.com



HYNES JOHN D. HYNES & ASSOCIATES, INC. **32185 Beaver Run Drive • Salisbury, Maryland 21804** **410-546-6462 / Fax: 410-548-5346**	**Date: August 13, 2012** **Scale: Not To Scale** **Drawn: ADC**
Project Location Map DelTech Administration Building Addition – Terry Campus Dover, Delaware	**DWG. No.** **JDH-10/12/307-A**



JOHN D. HYNES & ASSOCIATES, INC.

32185 Beaver Run Drive • Salisbury, Maryland 21804

410-546-6462 / Fax: 410-548-5346

	Date: August 13, 2012
	Scale: Not To Scale
	Drawn: BMG, Inc.
Boring Location Plan DelTech Administration Building Addition – Terry Campus Dover, Delaware	DWG. No. JDH-10/12/307-B

HYNES & ASSOCIATES

LOG OF BORING S-3

Becker Morgan Group, Inc.
312 West Main Street
Salisbury, Maryland 21801

DelTech Administration Building Addition

Project No.: JDH-10/12/307

Date Completed: : October 8, 2012
Logged By: : J. Hynes
Drilled By: : B. Anderson
Drilling Method: : Hand Auger
Total Depth: : 10 feet

Depth in Feet	Surf. Elev. 40.5	DESCRIPTION	GRAPHIC	USCS	Sample	Remarks
0	40	Brown, wet, SILT, with little fine to medium sand, trace organic silt (Silt loam)		ML	1	Scale 1" ~ 6 feet
2	38	Brown, wet, fine to coarse SAND and SILT (Sandy loam)		SM-ML	2	Approximately 24 inches organic bearing soil was encountered at the ground surface.
4	36	Brown, moist to wet, fine to coarse SAND, with trace silt (Sand)		SP	3	Groundwater was not encountered during augering operations.
6	34	Brown, wet, fine to medium SAND, with some silt, trace clay (Sandy loam)		SM		Note: Surface Elevations estimated from BMG, Inc. Plan C-201, dated 07/16/12.
8	32				4	
10	30	Boring terminated at 10 feet.			5	
12	28					
14	26					
16	24					
18	22					
20	20					
22	18					
24	16					
26	14					
28	12					
30	10					
32	8					
34	6					
36	4					
38	2					
40						

INFILTRATION TEST DATA SHEET

JOB NAME: Deltech Administration Building

PROJECT NUMBER: JDH-10/12/307 **TEST LOCATION:** I-1

TEST DATE: October 8, 2007 **TEST DEPTH:** 6.00 ft

	TIME	DEPTH TO WATER BELOW GROUND SURFACE	HYDRAULIC HEAD	Δ HYDRAULIC HEAD	PERMEABILITY (K_m)		COMMENTS
Test Hour 1	10:00	4.00 ft	2.00 ft				
	10:15	4.50 ft	1.50 ft	0.50 ft			
	10:30	4.85 ft	1.15 ft	0.35 ft			
	10:45	5.40 ft	0.60 ft	0.55 ft			
	11:00	5.60 ft	0.40 ft	0.20 ft	1.60 ft/hr	19.20 in/hr	
Test Hour 2	11:15	5.75 ft	0.25 ft	0.15 ft			
	11:30	4.00 ft	2.00 ft	0.00 ft			Excavation dry. Refilled.
	11:45	5.30 ft	0.70 ft	1.30 ft			
	12:00	5.55 ft	0.45 ft	0.25 ft	1.70 ft/hr	20.40 in/hr	Refilled to 4.0' bgs
Test Hour 3	12:15	4.42 ft	1.58 ft	0.42 ft			
	12:30	4.70 ft	1.30 ft	0.28 ft			
	12:45	4.90 ft	1.10 ft	0.20 ft			
	1:00	5.10 ft	0.90 ft	0.20 ft	1.10 ft/hr	13.20 in/hr	Refilled to 4.0' bgs
Test Hour 4	1:15	4.25 ft	1.75 ft	0.25 ft			
	1:30	4.50 ft	1.50 ft	0.25 ft			
	1:45	4.72 ft	1.28 ft	0.22 ft			
	2:00	4.90 ft	1.10 ft	0.18 ft	0.90 ft/hr	10.80 in/hr	Refilled to 4.0' bgs
Test Hour 5	2:15	4.33 ft	1.67 ft	0.33 ft			
	2:30	4.45 ft	1.55 ft	0.12 ft			
	2:45	4.60 ft	1.40 ft	0.15 ft			
	3:00	4.76 ft	1.24 ft	0.16 ft	0.76 ft/hr	9.12 in/hr	

There are generally two acceptable methods to calculate steady state infiltration rates:
1. Time Weighted Average: 13.38 in./hour
2. Final Test Hour Reading: 9.12 in./hour

Falling Head
Single Ring Infiltration Test

Tools and Supplies:

- ☐ 15 gallons of clean water per test
- ☐ 4 inch diameter thin wall PVC pipe
- ☐ Sledge Hammer
- ☐ 3- inch hand auger bucket
- ☐ Shovels Flat/Round
- ☐ Hand Auger 4-inch bucket (with extensions)
- ☐ Driving Block
- ☐ 5 gallon buckets
- ☐ Water level indicator
- ☐ Gator/ATV (as necessary)

Procedure:

A. Unless directed otherwise, advance one soil boring at each test location. The boring should extend to groundwater. Accurately measure depth to groundwater and depth of each soil change. Pay close attention to soils for mottling. Contact office to determine test depth. Note: This step can be omitted if test borings were advanced during a previous site visit.

B. Advance a 4-inch diameter soil boring to the specified test depth. **Check boring log to ensure that soil at bottom of excavation is soil type to be tested.**

C. Cut thin wall PVC to length (approximately 1 to 2' longer than desired test depth).

D. Push/drive PVC to bottom of soil boring.

E. Using 3-inch auger, clean out bottom of test hole to remove any soils that caved in during PVC placement. Drive PVC casing an additional 2 inches to ensure that bottom of test hole does not extend beyond the bottom of the PVC pipe.

F. Collect initial test information using water level indicator
1. Determine the total depth to the bottom of the hole from top of pipe and record.
2. Determine riser height above ground and record.
3. Subtract 2 feet from total depth (See F.1.) and record.

G. Start Test
1. Set up water level indicator at depth determined in F.3.
2. Fill tube with water until water level indicator alarms. To minimize soil scouring, slowly pour water down the inside of the casing wall.
3. Record exact depth to water with water level indicator.

H. Run Test:
1. Pre-soak (1 hour or less).
   a. Record depth to water every 15 minutes for first hour (pre-soak).
   b. At the end of first hour refill pipe with water to level determined in Step F.3.

Falling Head
Single Ring Infiltration Test

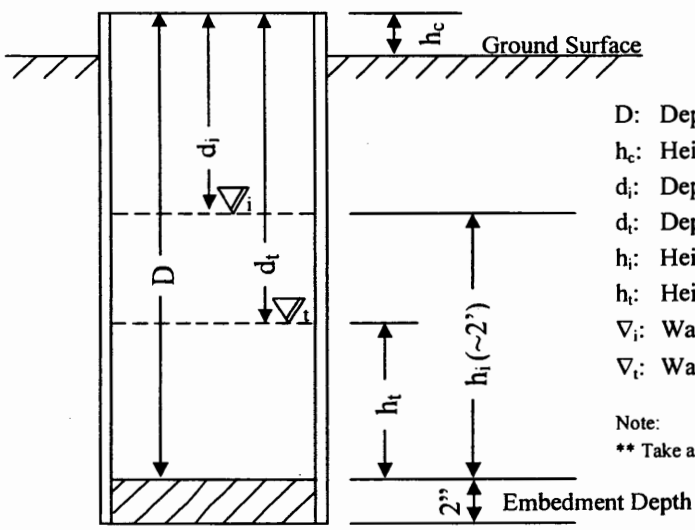
2. Infiltration testing (four, one hour tests)\
    a. Test starts after completing Step H.1.b.
    b. Record depth of water every 15 minutes (or more frequently)for one hour, or until water drains from pipe (which ever occurs first.
    c. Refill pipe with water to level determined in Step F.3.
    d. Repeat steps H.2.b. and c. three additional times (four test runs).
    e. Testing concludes after pre-soak and four test runs are completed.

I. Calculations

Infiltration rate is calculated as inches per hour.

Determine the water level drop recorded during each one hour test (note that the water level indicator is marked in tenths of a foot. A conversion to inches is required). Multiply the water level drop recorded in tenths of a foot by 1.2 to get water level drop in inches.

All data should be recorded on pre-made forms.



D: Depth from top of casing to bottom of boring.
h_c: Height of casing above ground surface.
d_i: Depth to water at time t=0.
d_t: Depth to water at time t.
h_i: Height of water at time t=0.
h_t: Height of water at time t.
∇_i: Water level at time t=0.
∇_t: Water level at time t.

Note:
** Take all measurements to 1/100 inch

Falling Head
Single Ring Infiltration Test

Date: _____ **Test Location:** _____

Depth from top of Casing to Bottom of Boring (D): _____

Height of Casing above Ground Surface (h_c): _____

Tester/ Technician Performing Test: _____

Time (t)	Time Elapsed	Depth to Water (d_t) (measured from top of casing to bottom of boring to the nearest 1/100 foot)	Change

HYNES

FIELD CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

NON-COHESIVE SOILS
(Silt, Sand, Gravel and Combinations)

DENSITY

Very Loose	- 5 blows/ft. or less
Loose	- 6 to 10 blows/ft.
Medium Dense	- 11 to 30 blows/ft.
Dense	- 31 to 50 blows/ft.
Very Dense	- 51 blows/ft. or more

RELATIVE PROPORTIONS

Descriptive Term	Percent
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

PARTICLE SIZE IDENTIFICATION

Boulders	- 8 inch diameter or more
Cobbles	- 3 to 8 inch diameter
Gravel	- Coarse - 1 to 3 inch
	- Medium - 1/2 to 1 inch
	- Fine - 4.75 mm to 1/2 inch
Sand	- Coarse - 2.0 mm to 4.75 mm
	- Medium - 0.425 mm to 2.0 mm
	- Fine - 0.075 mm to 0.425 mm
Silt	- 0.075 mm to 0.002 mm

COHESIVE SOILS
(Clay, Silt and Combinations)

CONSISTENCY

Very Soft	- 3 blows/ft. or less
Soft	- 4 to 5 blows/ft.
Medium Stiff	- 6 to 10 blows/ft.
Stiff	- 11 to 15 blows/ft.
Very Stiff	- 16 to 30 blows/ft.
Hard	- 31 blows/ft. or more

PLASTICITY

Degree of Plasticity	Plasticity Index
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	over 22

Classification on logs are made by visual inspection of samples unless a sample has been subjected to laboratory classification testing.

Standard Penetration Test - Driving a 2.0" O.D., 1-3/8" I.D., splitspoon sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. It is customary to drive the spoon 6 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and making the test are recorded for each 6 inches of penetration on the drill log (Example - 6/8/9). The standard penetration test value (N - value) can be obtained by adding the last two figures (i.e. 8 + 9 = 17 blows/ft.). (ASTM D-1586)

Strata Changes - In the column "Soil Descriptions," on the drill log, the horizontal lines represent strata changes. A solid line (—) represents an actually observed change, a dashed line (----) represents an estimated change.

Groundwater - Observations were made at the times indicated. Porosity of soil strata, weather conditions, site topography, etc. may cause changes in the water levels indicated on the logs.

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410-546-6462 • Fax 410-548-5346

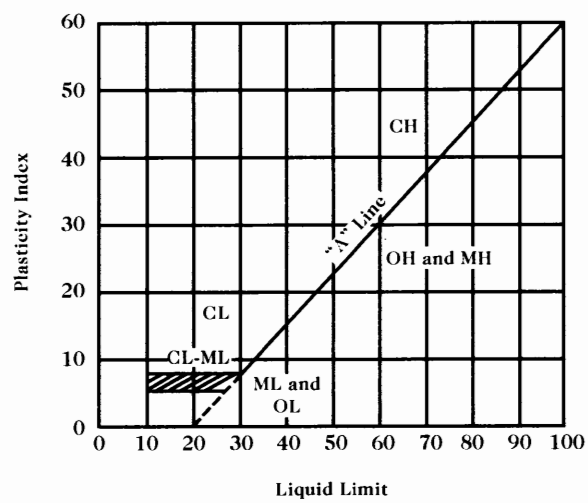
JOHN D. HYNES & ASSOCIATES, INC.

Geotechnical and Environmental Consultants
Monitoring Well Installation
Construction Inspection and Materials Testing

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions			*Group Symbols*	*Typical Names*	*Laboratory Classification Criteria*		
Coarse-grained soils (More than half of material is larger than No 200 sieve size)	Gravels (More than half of coarse fraction is larger than No 4 sieve size)	Clean gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No 200 sieve size), coarse grained soils are classified as follows: Less than 5 percent: GW, GP, SW, SP; More than 12 percent: GM, GC, SM, SC; 5 to 12 percent: *Borderline cases requiring dual symbols*[a]	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	Poorly graded gravels, gravel sand mixtures, little or no fines		Not meeting all graduation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GM[a] d / u	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than No 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands,		$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	Poorly graded sands, gravelly sands, little or no fines		Not meeting all graduation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM[a] d / u	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols.
			SC	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
Fine-grained soils (More than half material is smaller than No 200 sieve)	Silts and clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity			
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL	Organic silts and organic silty clays of low plasticity			
	Silts and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH	Inorganic clays of high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity, organic silts			
	Highly organic soils		Pt	Peat and other highly organic soils			

Plasticity Chart

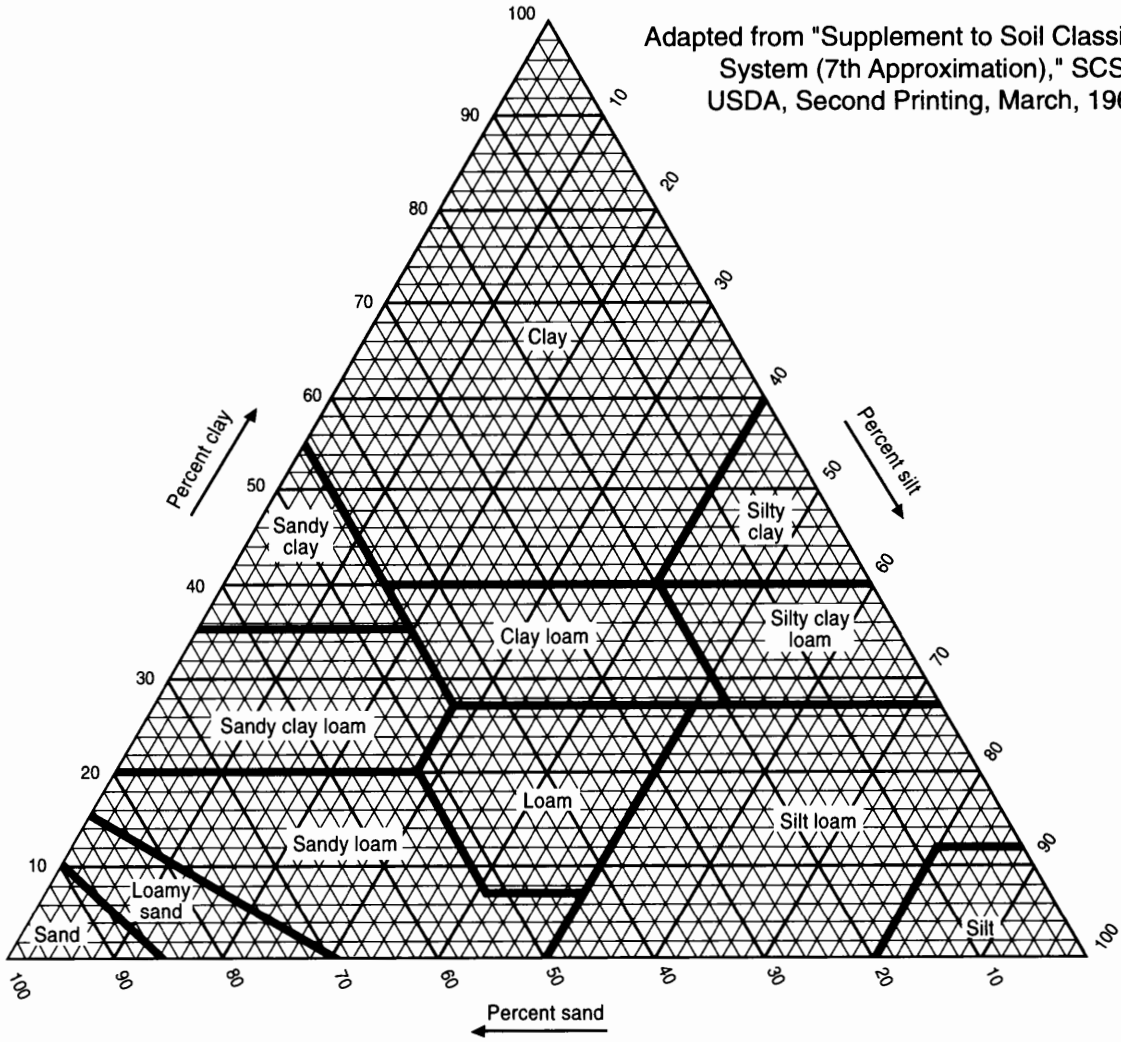


☐ *Main Office* - 32185 Beaver Run Drive • Salisbury, Maryland 21804 • 410-546-6462 • Fax 410-548-5346
☐ *Dover Office* - 1039 Fowler Court • Dover, Delaware 19901 • 302-678-9718 • Fax 302-678-9733
E-mail - Salisbury jdhynes@aol.com

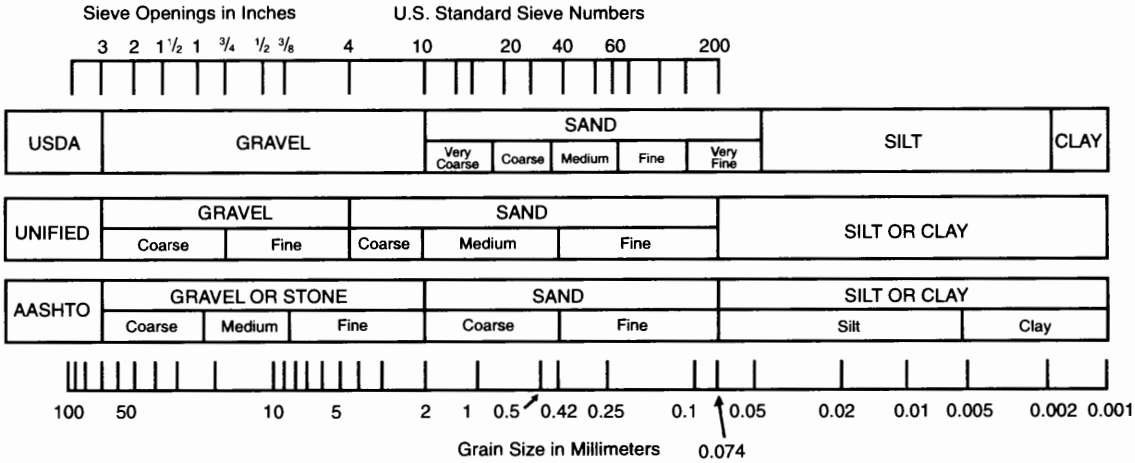
HYNES

USDA SOIL CLASSIFICATION SYSTEM

Adapted from "Supplement to Soil Classification System (7th Approximation)," SCS, USDA, Second Printing, March, 1967



COMPARISON OF PARTICLE - SIZE SCALES



Soil triangle of the basic soil textural classes. (U.S. Soil Conservation Service.) 288-D-2782.

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E-mail Salisbury jdhynes@aol.com

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one—not even you*—should apply the report for any purpose or project except the one originally contemplated.

Read the full report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, *do not rely on a geotechnical engineering report* that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions *only* at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an *opinion* about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject To Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce such risks, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations", many of these provisions indicate where geotechnical engineers responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Rely on Your Geotechnical Engineer for Additional Assistance

Membership in ASFE exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE

8811 Colesville Road Suite G106 Silver Spring, MD 20910

Telephone: 301-565-2733 Facsimile: 301-589-2017

email: info@asfe.org www.asfe.org

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UGER1000.10M

C-01 Fire Protection

BID FORM

For Bids Due: _____ To: EDiS Company
110 S. Poplar Street
Wilmington, DE 19801

Name of Bidder: _____

Bidder Address: _____

_____

Contact Name: _____ E-Mail Address: _____

Delaware Business License No.:_____ Taxpayer ID No.: _____

(Other License Nos.): _____

Phone No.: ( ) _____ - _____ Fax No.: ( ) _____ - _____

The undersigned, representing that he has read and understands the Bidding Documents and that this bid is made in accordance therewith, that he has visited the site and has familiarized himself with the local conditions under which the Work is to be performed, and that his bid is based upon the materials, systems and equipment described in the Bidding Documents without exception, hereby proposes and agrees to provide all labor, materials, plant, equipment, supplies, transport and other facilities required to execute the work described by the aforesaid documents for the lump sum itemized below:

$_____ ($_____)

ALTERNATES
None

UNIT PRICES

Unit prices conform to applicable project specification section. Refer to the specifications for a complete description of the following Unit Prices:

		BULK		TRENCH	
		Add	Deduct	Add	Deduct
1.	Price per cubic yard for rock excavation as specified in excavation section.	_____	_____	_____	_____
2.	Price per cubic yard for earth excavation as specified in excavation section.	_____	_____	_____	_____

3.	Price per cubic yard for earth excavation by hand.	_____	_____	_____	_____
4.	Price per cubic yard for reinforced concrete on grade	_____	_____	_____	_____

NOTE: The difference in price between Add and Deduct in the above Unit Prices should not exceed fifteen percent (15%).

I/We acknowledge Addendums numbered _____ and the price(s) submitted include any cost/schedule impact they may have.

This bid shall remain valid and cannot be withdrawn for sixty (60) days (Project Manager's Note: Verify and coordinate with Section 00100 Instruction to Bidders.) from the date of opening of bids, and the undersigned shall abide by the Bid Security forfeiture provisions. Bid Security is attached to this Bid (if required).

The Owner shall have the right to reject any or all bids, and to waive any informality or irregularity in any bid received.

This bid is based upon work being accomplished by the Sub-Contractors named on the list attached to this bid.

The undersigned represents and warrants that he has complied and shall comply with all requirements of local, state, and national laws; that no legal requirement has been or shall be violated in making or accepting this bid, in awarding the contract to him or in the prosecution of the work required; that the bid is legal and firm; that he has not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken action in restraint of free competitive bidding.

Upon receipt of written notice of the acceptance of this Bid, the Bidder shall, within twenty (20) calendar days, execute the agreement in the required form and deliver the Contract Bonds, and Insurance Certificates, required by the Contract Documents.

I am / We are an Individual / a Partnership / a Corporation

By _____ Trading as _____
(Individual's / General Partner's / Corporate Name)

_____
(State of Corporation)

Business Address:_____
_____
_____
_____

Witness: _____ By: _____

(Authorized Signature)

(SEAL) _____

(Title)

Date: _____

ATTACHMENTS

Sub-Contractor List
Non-Collusion Statement
Bid Bond
Consent of Surety
(Others as Required by Project Manuals)

SUBCONTRACTOR LIST

In accordance with Title 29, Chapter 6962 (d)(10)b Delaware Code, the following sub-contractor listing must accompany the bid submittal. The name and address of the sub-contractor must be listed for each category where the bidder intends to use a sub-contractor to perform that category of work. In order to provide full disclosure and acceptance of the bid by the Owner, it is required that bidders list themselves as being the sub-contractor for all categories where he/she is qualified and intends to perform such work.

Subcontractor Category	Subcontractor	Address (City & State)
N/A		

NON-COLLUSION STATEMENT

This is to certify that the undersigned bidder has neither directly nor indirectly, entered into any agreement, participated in any collusion or otherwise taken any action in restraint of free competitive bidding in connection with this proposal submitted this date _____

All the terms and conditions of **(C-1 Fire Protection)** have been thoroughly examined and are understood.

NAME OF BIDDER: _____

AUTHORIZED REPRESENTATIVE (TYPED): _____

AUTHORIZED REPRESENTATIVE (SIGNATURE): _____

TITLE: _____

ADDRESS OF BIDDER: _____

_____

_____

PHONE NUMBER: _____

Sworn to and Subscribed before me this _____ day of _____ 20____.

My Commission expires _____. NOTARY PUBLIC _____.

THIS PAGE MUST BE SIGNED AND NOTARIZED FOR YOUR BID TO BE CONSIDERED.

BID BOND

TO ACCOMPANY PROPOSAL
(Not necessary if security is used)

KNOW ALL MEN BY THESE PRESENTS That: _____of _____in the County of _____ and State of _____ as Principal, and _____of _____in the County of _____ _____ and State of _____ as Surety, legally authorized to do business in the State of Delaware ('State"), are held and firmly unto the Delaware Technical Community College in the sum of _____ _____ Dollars (S_____), or percent not to exceed _____ _____ Dollars (S_____) of amount of bid on Contract No. _____ to be paid to the Delaware Technical Community College for the use and benefit of the Delaware Technical Community College for which payment well and truly to be made, we do bind ourselves, our and each of our heirs, executors, administrators. and successors, jointly and severally for and in the whole firmly by these presents.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH That if the above bounden Principal who has submitted to the Delaware Technical Community College a certain proposal to enter into this contract for the furnishing of certain material and/or services within the State, shall be awarded this Contract, and if said Principal shall well and truly enter into and execute this Contract as may be required by the terms of this Contract and approved by the Delaware Technical Community College this Contract to be entered into within twenty days after the date of official notice of the award thereof in accordance with the terms of said proposal, then this obligation shall be void or else to be and remain in full force and virtue.

Sealed with _____seal and dated this____day of _____in the year of our Lord two thousand and _____(20__).

SEALED, AND DELIVERED IN THE PRESENCE OF

_____
Name of Bidder (Organization)

Corporate Seal

By:_____
Authorized Signature

Attest _____

_____
Title

_____
Name of Surety

Witness_____

_____

_____
Title

CONSENT OF SURETY

DATE_____

To: Delaware Technical Community College
100 Campus Drive
Dover, DE 19904-1383

Gentlemen:

We, the _____

_____
(Surety Company's Address)

_____

a Surety Company authorized to do business in the State of Delaware hereby agrees that if

_____
(Contractor)

_____
(Address)

_____

is awarded the Contract No. _____

We will write the required Performance and/or Labor and Material Bond required by Paragraph 9 of the Instructions to Bidders.

_____
(Surety Company)

By _____
(Attorney-in-Fact)

END OF SECTION

C-02 Automatic Temperature Controls

BID FORM

For Bids Due: _____ To: EDiS Company
110 S. Poplar Street
Wilmington, DE 19801

Name of Bidder: _____

Bidder Address: _____

_____

Contact Name: _____ E-Mail Address: _____

Delaware Business License No.:_____ Taxpayer ID No.: _____

(Other License Nos.): _____

Phone No.: ( ) _____ - _____ Fax No.: ( ) _____ - _____

The undersigned, representing that he has read and understands the Bidding Documents and that this bid is made in accordance therewith, that he has visited the site and has familiarized himself with the local conditions under which the Work is to be performed, and that his bid is based upon the materials, systems and equipment described in the Bidding Documents without exception, hereby proposes and agrees to provide all labor, materials, plant, equipment, supplies, transport and other facilities required to execute the work described by the aforesaid documents for the lump sum itemized below:

$_____ ($_____)

ALTERNATES

None

UNIT PRICES

Unit prices conform to applicable project specification section. Refer to the specifications for a complete description of the following Unit Prices:

		BULK		TRENCH	
		Add	Deduct	Add	Deduct
1.	Price per cubic yard for rock excavation as specified in excavation section.	_____	_____	_____	_____
2.	Price per cubic yard for earth excavation as specified in excavation section.	_____	_____	_____	_____

3. Price per cubic yard for earth excavation by hand. _____ _____ _____ _____

4. Price per cubic yard for reinforced concrete on grade _____ _____ _____ _____

NOTE: The difference in price between Add and Deduct in the above Unit Prices should not exceed fifteen percent (15%).

I/We acknowledge Addendums numbered _____ and the price(s) submitted include any cost/schedule impact they may have.

This bid shall remain valid and cannot be withdrawn for sixty (60) days (Project Manager's Note: Verify and coordinate with Section 00100 Instruction to Bidders.) from the date of opening of bids, and the undersigned shall abide by the Bid Security forfeiture provisions. Bid Security is attached to this Bid (if required).

The Owner shall have the right to reject any or all bids, and to waive any informality or irregularity in any bid received.

This bid is based upon work being accomplished by the Sub-Contractors named on the list attached to this bid.

The undersigned represents and warrants that he has complied and shall comply with all requirements of local, state, and national laws; that no legal requirement has been or shall be violated in making or accepting this bid, in awarding the contract to him or in the prosecution of the work required; that the bid is legal and firm; that he has not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken action in restraint of free competitive bidding.

Upon receipt of written notice of the acceptance of this Bid, the Bidder shall, within twenty (20) calendar days, execute the agreement in the required form and deliver the Contract Bonds, and Insurance Certificates, required by the Contract Documents.

I am / We are an Individual / a Partnership / a Corporation

By _____ Trading as _____
(Individual's / General Partner's / Corporate Name)

_____
(State of Corporation)

Business Address:_____
_____
_____
_____

Witness: _____ By: _____

(Authorized Signature)

(SEAL) _____

(Title)

Date: _____

ATTACHMENTS

Sub-Contractor List
Non-Collusion Statement
Bid Bond
Consent of Surety
(Others as Required by Project Manuals)

SUBCONTRACTOR LIST

In accordance with Title 29, Chapter 6962 (d)(10)b Delaware Code, the following sub-contractor listing must accompany the bid submittal. The name and address of the sub-contractor must be listed for each category where the bidder intends to use a sub-contractor to perform that category of work. In order to provide full disclosure and acceptance of the bid by the Owner, it is required that bidders list themselves as being the sub-contractor for all categories where he/she is qualified and intends to perform such work.

Subcontractor Category	Subcontractor	Address (City & State)
N/A		

NON-COLLUSION STATEMENT

This is to certify that the undersigned bidder has neither directly nor indirectly, entered into any agreement, participated in any collusion or otherwise taken any action in restraint of free competitive bidding in connection with this proposal submitted this date _____

All the terms and conditions of ***(B-01, Sitework)*** have been thoroughly examined and are understood.

NAME OF BIDDER: _____

AUTHORIZED REPRESENTATIVE (TYPED): _____

AUTHORIZED REPRESENTATIVE (SIGNATURE): _____

TITLE: _____

ADDRESS OF BIDDER: _____

_____

_____

PHONE NUMBER: _____

Sworn to and Subscribed before me this _____ day of _____ 20____.

My Commission expires _____. NOTARY PUBLIC _____.

THIS PAGE MUST BE SIGNED AND NOTARIZED FOR YOUR BID TO BE CONSIDERED.

BID BOND

TO ACCOMPANY PROPOSAL
(Not necessary if security is used)

KNOW ALL MEN BY THESE PRESENTS That: _____of _____in the County of _____ and State of _____ as Principal, and _____of _____in the County of _____ _____ and State of _____ as Surety, legally authorized to do business in the State of Delaware ('State"), are held and firmly unto the Delaware Technical Community College in the sum of _____ _____ Dollars (S_____), or percent not to exceed _____ _____ Dollars (S_____) of amount of bid on Contract No. _____ to be paid to the Delaware Technical Community College for the use and benefit of the Delaware Technical Community College for which payment well and truly to be made, we do bind ourselves, our and each of our heirs, executors, administrators. and successors, jointly and severally for and in the whole firmly by these presents.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH That if the above bounden Principal who has submitted to the Delaware Technical Community College a certain proposal to enter into this contract for the furnishing of certain material and/or services within the State, shall be awarded this Contract, and if said Principal shall well and truly enter into and execute this Contract as may be required by the terms of this Contract and approved by the Delaware Technical Community College this Contract to be entered into within twenty days after the date of official notice of the award thereof in accordance with the terms of said proposal, then this obligation shall be void or else to be and remain in full force and virtue.

Sealed with _____seal and dated this____day of _____in the year of our Lord two thousand and _____(20__).

SEALED, AND DELIVERED IN THE PRESENCE OF

_____
Name of Bidder (Organization)

Corporate Seal

By:_____
Authorized Signature

Attest _____

_____
Title

_____
Name of Surety

Witness_____

_____

_____
Title

CONSENT OF SURETY

DATE_____

To: Delaware Technical Community College
100 Campus Drive
Dover, DE 19904-1383

Gentlemen:

We, the _____

_____
(Surety Company's Address)

_____

a Surety Company authorized to do business in the State of Delaware hereby agrees that if

_____
(Contractor)

_____
(Address)

_____

is awarded the Contract No. _____

We will write the required Performance and/or Labor and Material Bond required by Paragraph 9 of the Instructions to Bidders.

_____
(Surety Company)

By _____
(Attorney-in-Fact)

END OF SECTION

SECTION 005200 - AGREEMENT

1. SUMMARY

1.1. The Agreement Form for this Project is either the American Institute of Architects [Standard Form of Agreement between Owner and Contractor, Construction Manager as Advisor, AIA Document A101 - 2007 Edition]

1.2 A copy of AIA Document [A101 – 2007 Edition] is bound into this Project Manual following this page.

1.2.1 Under Article 5.1.4.5 add the following:

"Upon completion of the work under the Contract, the Owner may release 60% of the amount then retained. The balance of the amount retained will be held until:

A. All reports required of the Contract are received;
B. All Subcontractors in trades listed on the Bid Form are paid by the Contractor, unless the amount owed to the Subcontractor is disputed, in which case the Owner may withhold 150% of the amount withheld by the Contractor in its dispute with the Subcontractor; and
C. Final payment is authorized by the Owner."

END OF SECTION

Amendment to Contract for Construction
Between
Delaware Technical & Community College
And

_____

The parties hereby agree that the AIA Document A101 – 2007 "Standard Form of Agreement between Owner and Contractor" shall govern this transaction as supplemented and amended herein. The parties expressly agree that the terms of this amendment shall govern in the event of a conflict between the terms of the AIA Document or any document referenced or incorporated therein, and that any contrary provision of any such document shall be superseded hereby.

1. By signing this Agreement, Contractor swears that he has not employed or retained any company or person, other than a bona fide employee working primarily for the firm offering professional services, to solicit or secure this agreement, and that he has not been paid or agreed to pay any person, company, corporation, individual, or firm, other than a bona fide employee working primarily for the firm offering professional services, any fee, commission, percentage, gift, or any other consideration, contingent upon or resulting from the award or making of this agreement;

2. All provisions of the Bid Package and Project manual are incorporated herein by reference as though fully set forth. In the event of a conflict between any provision of the Bid Package or Project Manual and the bid or proposal submitted by Contractor, the Bid Package and Project Manual shall control.

3. Section 3.3 is amended to require substantial completion of all construction not later than ____ days from the commencement of construction. Time is of the essence. If the Contractor fails to complete the work within the time specified, the Contractor shall pay liquidated damages to the Owner in the amount of $_____ for each calendar day of delay until the work is completed or accepted. If the Owner terminates the Contractor's right to proceed, liquidated damages will continue to accrue until the work is completed. These liquidated damages are in addition to all sums and remedies available to Owner upon termination for cause.

4. In the event the attached contract or aggregate of contracts is in excess of $100,000 for new construction (including painting and decorating) or $15,000 for alteration, repair, renovation, rehabilitation, demolition or reconstruction (including painting and decorating of buildings or works) and requires or involves the employment of mechanics and/or laborers, then the minimum wages to be paid to the various classes of laborers and mechanics shall be based upon greater of the Davis-Bacon Wage Rates or the wages that will be determined by the Delaware Department of Labor, Division of Industrial Affairs, to be prevailing in the county in which the work is to be performed.

5. Contractor shall pay all mechanics and laborers employed directly upon the site of the work, unconditionally and not less often than once a week and without subsequent deduction or rebate on any account, the full amounts accrued at time of payment, computed at wage rates not less than the prevailing wages, regardless of any contractual relationship which may be alleged to exist between the employer and such laborers and mechanics, and shall provide sworn payroll information, as required by the Department of Labor, on a weekly basis.

6. All changes to the scope of construction shall be authorized in writing by Owner in advance. Owner shall not be liable for payment of any change order that has not received prior written authorization. The cost of any change order shall be set forth therein. If no such provision is set forth in the change order, then the cost to the Owner shall be the Contractor's costs for wages, labor costs other than wages, wage taxes, materiel, equipment rentals, insurance and subcontracts attributable to the additional activity plus a reasonable sum for overhead and profit not to exceed 5%;

7. Preference in employment of laborers, workers or mechanics shall be given to bona fide legal citizens of the State who have established citizenship by residence of at least 90 days in the State. Contractor shall pay a penalty to the Secretary of Finance equal to the amount of compensation paid to any person in violation of this section;

8. Contractor shall not substitute another subcontractor for any subcontractor whose name was set forth in the statement which accompanied the bid without the written consent of Owner. Contractor shall pay a penalty equal to 150% of the amount of the proposal or subcontract submitted by the subcontractor identified in the accompanying statement for violating this paragraph.

9. Payments are due 30 days after receipt of a valid Application for Payment. Payments due and unpaid after 30 days shall bear interest of one percent per month not to exceed twelve percent per annum;

10. Final payment shall not be due until all non-conforming work has been corrected and all other provisions of the agreement have been met, including, but not limited to, all reporting requirements. Furthermore, a written release of mechanics' liens signed by all persons who would otherwise be entitled to avail themselves of the provisions of Chapter 27 of Tile 25 of the Delaware Code, containing a notarized, verified certification signed by the Contractor that all of the persons signing the release constitute all of the persons who have furnished materials and performed labor in and for the construction, erection, building, improvement, alteration and repair to the date of the release and who would be entitled otherwise to file mechanics' liens claims shall be provided simultaneously with the receipt of final payment;

11. Owner may terminate this agreement or suspend work hereunder for any reason authorized by applicable Delaware law;

12. §6.2 is hereby deleted. The parties reserve all remedies available at law or equity for any dispute not resolved in accordance with §6.1. In the event legal action is instituted to enforce performance hereunder, the prevailing party shall be entitled to an award of attorneys fees and costs in addition to all other relief granted;

13. Simultaneous with the execution of the this contract, Contractor shall also execute a good and sufficient bond for the benefit of Owner, with corporate surety authorized to do business in this State, in a sum equal to 100% of the contract price and the bond form used shall be the standard form issued by the Office of Management and Budget;

14. The bond shall be conditioned upon the faithful compliance and performance by the successful bidder of each and every term and condition of the contract and the proposal and plans and specifications thereof, at the time and in the manner prescribed by the contract and the plans and specifications, including the payment in full, to every firm furnishing materiel or performing labor in the performance of the contract, of all sums of money due it for such labor or materiel. The bond shall also contain the Contractor's guarantee to indemnify and save harmless the Owner from all costs, damages and expenses growing out of or by reason of Contractor's failure to comply and perform the work and complete the contract in accordance with its terms. No firm or surety, in any action brought under 29 Del C §6962, or any successor law, or on the bond required by such statute, shall assert as a defense to such action the claim that the bond given contained a limitation or restriction not provided for by Chapter 69, Title 29 of the Delaware Code, the provisions of which are incorporated herein by reference as though fully set forth;

15. Owner shall have the right to terminate the contract upon receipt of notice from Contractor's surety that bond claims have been made or are anticipated to be made against Contractor on this or any other project of Contractor. If Owner elects to terminate the contract pursuant to this paragraph, it shall be deemed a termination for cause.

16. Owner may, when it considers that its interests so require, cause judgment to be confessed upon the bond. All sums received through confession of judgment shall be paid for the credit of the Owner to the Secretary of Finance;

17. Owner or any of its duly authorized representatives shall have access to any documents, books, papers, and records of Contractor (which are directly pertinent to a specific grant program) for the purpose of making an audit, examination, excerpts, and transcriptions. Contractor shall maintain all required records for at least three years after Owner makes final payment and all pending matters are closed;

18. Contractor shall submit a report to Owner not less frequently than monthly covering the general progress of the job and describing any problems or factors contributing to delay;

19. During the performance of this contract, the contractor agrees as follows:

The contractor will not discriminate against any employee or applicant for employment because of race, creed, color, sex, sexual orientation or national origin. The contractor will take positive steps to ensure that applicants are employed and that employees are treated during employment without regard to their race, creed, color, sex, sexual orientation or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places available to employees and applicants for employment notices to be provided by the contracting agency setting forth this nondiscrimination clause.

The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, sex, sexual orientation or national origin.

20. The parties agree that this agreement shall be governed by and construed pursuant to the laws of The State of Delaware, and that the Delaware courts shall have sole and exclusive jurisdiction of any dispute arising under this agreement.

IN WITNESS WHEREOF, the parties have set their hand and seal on this indenture on this _____ day of _____, 2012.

Delaware Technical & Community College

_____(Seal)
Orlando J. George, Jr, President

(Contractor)

_____(Seal)
By:

DRAFT

AIA® Document A101™ – 2007

Standard Form of Agreement Between Owner and Contractor
where the basis of payment is a Stipulated Sum

AGREEMENT made as of the « » day of « » in the year « »
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

Delaware Technical Community College
Terry Campus
100 Campus Drive
Dover De 19903

and the Contractor:
(Name, legal status, address and other information)

« »« »
« »
« »
« »

for the following Project:
(Name, location and detailed description)

Central Administration Building Expansion and Renovation
100 Campus Drive
Dover, De 19903

The Architect:
(Name, legal status, address and other information)

Becker Morgan Group
Port Exchange, Suite 300
312 West Main Street
Salisbury, MD 21801

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

AIA Document A201™–2007, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

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ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be the date of this Agreement unless a different date is stated below or provision is made for the date to be fixed in a notice to proceed issued by the Owner.
(Insert the date of commencement if it differs from the date of this Agreement or, if applicable, state that the date will be fixed in a notice to proceed.)

« »

If, prior to the commencement of the Work, the Owner requires time to file mortgages and other security interests, the Owner's time requirement shall be as follows:

« »

§ 3.2 The Contract Time shall be measured from the date of commencement.

§ 3.3 The Contractor shall achieve Substantial Completion of the entire Work not later than « » (« ») days from the date of commencement, or as follows:
(Insert number of calendar days. Alternatively, a calendar date may be used when coordinated with the date of commencement. If appropriate, insert requirements for earlier Substantial Completion of certain portions of the Work.)

« »

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Portion of Work	Substantial Completion Date

, subject to adjustments of this Contract Time as provided in the Contract Documents.
(Insert provisions, if any, for liquidated damages relating to failure to achieve Substantial Completion on time or for bonus payments for early completion of the Work.)

« »

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be « » ($ « »), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 The Contract Sum is based upon the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:
(State the numbers or other identification of accepted alternates. If the bidding or proposal documents permit the Owner to accept other alternates subsequent to the execution of this Agreement, attach a schedule of such other alternates showing the amount for each and the date when that amount expires.)

« »

§ 4.3 Unit prices, if any:
(Identify and state the unit price; state quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price Per Unit ($0.00)

§ 4.4 Allowances included in the Contract Sum, if any:
(Identify allowance and state exclusions, if any, from the allowance price.)

Item	Price

ARTICLE 5 PAYMENTS

§ 5.1 PROGRESS PAYMENTS

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

« »

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the « » day of a month, the Owner shall make payment of the certified amount to the Contractor not later than the « » day of the « » month. If an Application for Payment is received by the Architect after the application date fixed above, payment shall be made by the Owner not later than « » (« ») days after the Architect receives the Application for Payment.
(Federal, state or local laws may require payment within a certain period of time.)

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment.

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§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 Subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

.1 Take that portion of the Contract Sum properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the Contract Sum allocated to that portion of the Work in the schedule of values, less retainage of « » percent (« » %). Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute shall be included as provided in Section 7.3.9 of AIA Document A201™–2007, General Conditions of the Contract for Construction;

.2 Add that portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing), less retainage of « » percent (« » %);

.3 Subtract the aggregate of previous payments made by the Owner; and

.4 Subtract amounts, if any, for which the Architect has withheld or nullified a Certificate for Payment as provided in Section 9.5 of AIA Document A201–2007.

§ 5.1.7 The progress payment amount determined in accordance with Section 5.1.6 shall be further modified under the following circumstances:

.1 Add, upon Substantial Completion of the Work, a sum sufficient to increase the total payments to the full amount of the Contract Sum, less such amounts as the Architect shall determine for incomplete Work, retainage applicable to such work and unsettled claims; and
(Section 9.8.5 of AIA Document A201–2007 requires release of applicable retainage upon Substantial Completion of Work with consent of surety, if any.)

.2 Add, if final completion of the Work is thereafter materially delayed through no fault of the Contractor, any additional amounts payable in accordance with Section 9.10.3 of AIA Document A201–2007.

§ 5.1.8 Reduction or limitation of retainage, if any, shall be as follows:
(If it is intended, prior to Substantial Completion of the entire Work, to reduce or limit the retainage resulting from the percentages inserted in Sections 5.1.6.1 and 5.1.6.2 above, and this is not explained elsewhere in the Contract Documents, insert here provisions for such reduction or limitation.)

« »

§ 5.1.9 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 FINAL PAYMENT

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

.1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Section 12.2.2 of AIA Document A201–2007, and to satisfy other requirements, if any, which extend beyond final payment; and

.2 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment, or as follows:

« »

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ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 INITIAL DECISION MAKER

The Architect will serve as Initial Decision Maker pursuant to Section 15.2 of AIA Document A201–2007, unless the parties appoint below another individual, not a party to this Agreement, to serve as Initial Decision Maker.
(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

« »
« »
« »
« »

§ 6.2 BINDING DISPUTE RESOLUTION

For any Claim subject to, but not resolved by, mediation pursuant to Section 15.3 of AIA Document A201–2007, the method of binding dispute resolution shall be as follows:
(Check the appropriate box. If the Owner and Contractor do not select a method of binding dispute resolution below, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.)

[« »] Arbitration pursuant to Section 15.4 of AIA Document A201–2007

[« »] Litigation in a court of competent jurisdiction

[« »] Other *(Specify)*

« »

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2007.

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2007.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2007 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.
(Insert rate of interest agreed upon, if any.)

« » % « »

§ 8.3 The Owner's representative:
(Name, address and other information)

« »
« »
« »
« »
« »
« »

§ 8.4 The Contractor's representative:
(Name, address and other information)

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« »
« »
« »
« »
« »
« »

§ 8.5 Neither the Owner's nor the Contractor's representative shall be changed without ten days written notice to the other party.

§ 8.6 Other provisions:

« »

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 The Contract Documents, except for Modifications issued after execution of this Agreement, are enumerated in the sections below.

§ 9.1.1 The Agreement is this executed AIA Document A101–2007, Standard Form of Agreement Between Owner and Contractor.

§ 9.1.2 The General Conditions are AIA Document A201–2007, General Conditions of the Contract for Construction.

§ 9.1.3 The Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

§ 9.1.4 The Specifications:
(Either list the Specifications here or refer to an exhibit attached to this Agreement.)
« »

Section	Title	Date	Pages

§ 9.1.5 The Drawings:
(Either list the Drawings here or refer to an exhibit attached to this Agreement.)
« »

Number	Title	Date

§ 9.1.6 The Addenda, if any:

Number	Date	Pages

Portions of Addenda relating to bidding requirements are not part of the Contract Documents unless the bidding requirements are also enumerated in this Article 9.

§ 9.1.7 Additional documents, if any, forming part of the Contract Documents:

.1 AIA Document E201™–2007, Digital Data Protocol Exhibit, if completed by the parties, or the following:

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« »

.2 Other documents, if any, listed below:
(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201–2007 provides that bidding requirements such as advertisement or invitation to bid, Instructions to Bidders, sample forms and the Contractor's bid are not part of the Contract Documents unless enumerated in this Agreement. They should be listed here only if intended to be part of the Contract Documents.)

« »

ARTICLE 10 INSURANCE AND BONDS

The Contractor shall purchase and maintain insurance and provide bonds as set forth in Article 11 of AIA Document A201–2007.
(State bonding requirements, if any, and limits of liability for insurance required in Article 11 of AIA Document A201–2007.)

Type of insurance or bond	Limit of liability or bond amount ($0.00)

This Agreement entered into as of the day and year first written above.

OWNER *(Signature)*	**CONTRACTOR** *(Signature)*
« »« »	« »« »
(Printed name and title)	*(Printed name and title)*

DRAFT

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SUPPLEMENTARY CONDITIONS TO AIA A201-2007

These Supplementary Conditions dated _____ modify the AIA Document A201 - 2007 General Conditions of the Contract for Construction ("General Conditions"), for use with the Standard Form of Agreement between Owner and Contractor (the "Agreement") by and between EDiS Company ("Contractor") and _____ ("Owner").

ARTICLE 1: GENERAL PROVISIONS

1. §1.1.2 Delete the last sentence.

2. §1.1.3 Delete "whether completed or partially completed…"from the first sentence.

ARTICLE 2: OWNER

3. §2.1.1 Insert a period after the word "matters" in the second sentence and delete the rest of the sentence.

4. §2.2.1 Insert "and from time to time thereafter" after the word "Work" and before the word "the" in the first line of the paragraph. Delete the second sentence. In the third sentence add a period after "continuation of the Work" and delete the remainder of the sentence. In the fourth sentence, delete the word "materially".

5. §2.3 In the second line, replace "repeatedly" with "persistently and willfully".

6. §2.4 In the second sentence, delete the words "Owner's expenses and".

ARTICLE 3: CONTRACTOR

7. §3.2.1 Insert a period after the word "performed" and delete the rest of the sentence.

8. §3.2.2 In the first sentence delete "Because the Contract Documents are complementary,". In the second line replace the words "carefully study and compare" with "review". In the second sentence, delete the words "coordination and" and "or made known to".

9. §3.2.4 At the end of the paragraph, replace the period with a comma and add "unless the Contractor recognized such error, inconsistency, omission, difference, or non-conformity and knowingly failed to report it.

10. §3.3.1 In the last sentence, add the word "resulting" after the word "any" and before the word "loss". Insert a period after the word "damage" and delete the remainder of the sentence.

11. §3.5 In the first sentence, delete "and Architect" and "of good quality and". In the second sentence replace "defective" with "nonconforming". At the end of the paragraph add "Other than above, the Contractor makes no other warranty, representation, or guarantee, whether express or implied and such are expressly disclaimed."

12. §3.7.5 In the first sentence, add the word "knowingly" after the word "Contractor" and before the word "encounters".

13. §3.12.6 In the first sentence, delete "and Architect". At the end of the paragraph add "The Contractor is relying on the Architect's having fully coordinated the design drawings in making the above representation."

14. §3.12.10 In the first sentence insert a period after "…Contract Documents" and delete the remainder of the sentence. In the third sentence, delete "related to systems, materials or equipment".

15. Add new §3.18.3:

The Owner shall indemnify and hold the Contractor and the Contractor's officers and employees harmless from and against damages, losses and judgments arising from claims by third parties, including reasonable attorneys' fees and expenses recoverable under applicable law, but only to the extent they are caused by the negligent acts or omissions of the Owner, its employees or anyone for whom Owner is responsible

ARTICLE 4: ARCHITECT

16. §4.2.1 Delete the words "and will be an Owner's representative" from the sentence.

17. §4.2.7 In the first sentence, insert a period after the word "Samples" and delete the rest of the sentence. In the second sentence, insert "as to cause no delay in the Work, or in the activities of the Contractor or Owner," after the word "promptness" and before the word "while".

ARTICLE 5: SUBCONTRACTORS

18. §5.2.1 In the first sentence, delete the words "through the Architect". In the second sentence, start with "The Owner" and delete "Architect" and delete "or the Architect" after "(1)" and replace "Architect" with "Owner" after "(2)". In the last sentence, delete "or Architect".

19. §5.2.4 Delete paragraph.

20. §5.3 In the first sentence, delete "and Architect". In the second sentence, delete "and Architect". In the fourth sentence delete "prior to the execution of the subcontract agreement,". In the fourth sentence insert a period after the word "bound" and delete the remainder of the sentence.

ARTICLE 6: CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

21. §6.1.3 At the end of the second sentence add "when directed to do so." In the third sentence, add "and Contract Sum" after the word "schedule" and before the word "deemed".

22. §6.2.2 In the first sentence, replace the word "apparent" with the word "known".

23. §6.2.3 Delete paragraph.

ARTICLE 7: CHANGES TO THE WORK

24. §7.3.3 Delete "If" at the beginning of the first sentence. Insert the word "shall" after the word "Directive" and before the word "provides". Change "provides" to "provide".

25. §7.3.7 After subparagraph .5, add a new paragraph that reads: "The Architect's determination, as specified above, shall not be less than the actual costs expended by the Contractor in performing the changed Work. If the Architect's determination is believed by the Contractor to be less than its actual costs (incurred or projected) in performing the Work, the Contractor may initiate dispute resolution pursuant to Article 15."

26. §7.4 Replace "Architect" with "Owner" wherever it appears in this paragraph.

ARTICLE 8: TIME

27. §8.1.3 Replace "certified by the Architect" with "as established".

28. §8.2.1 Delete the second sentence.

29. §8.3.1 In the first sentence delete "by an act or neglect of the Owner or Architect, or of any employee of either, or of a separate contractor employed by the Owner; or by changes ordered in the Work; or".

ARTICLE 9: PAYMENTS AND COMPLETION

30. §9.3.1 In the second sentence insert the word "reasonably" after the word "may" and before the word "require" Insert a period after "require" and delete the remainder of the sentence.

31. §9.3.1.2 Delete paragraph.

32. §9.3.2 At the beginning of the second sentence, delete "If approved in advance by the Owner,". In the last sentence, delete "applicable insurance,".

33. §9.4.2 In the first sentence, delete "to the best of the Architect's knowledge, information and belief,".

34. §9.5.1 In the fourth sentence delete "or, because of subsequently discovered evidence, may nullify the whole or part of a Certificate for Payment previously issued". In subparagraph .2, delete "or reasonable evidence indicating probable filing of such claims". In subparagraph .3, delete "properly". In subparagraph .7, replace "repeated" with "persistent".

35. §9.5.3 Delete and replace with the following:

Owner may not withhold payment, pursue any claim for penalty, damages, offset or backcharge and such claim shall be deemed waived unless Contractor was given written advance notice of the deficiency by the Owner, was allowed reasonable time to correct the deficiency, and failed to do so.

36. §9.6.3 Delete paragraph.

37. §9.6.4 Delete the second sentence.

38. §9.7 Delete and replace with the following:

Contractor may suspend performance under this Agreement if at any time any payment, reimbursement or costs are due and outstanding for a period of more than forty-five (45) calendar days from the date of any application for payment, such failure of payment shall represent material nonperformance by the Owner and cause for termination of the Agreement, or, at the Contractor's option, cause for suspension of performance of all services under the Agreement. If the Contractor elects to suspend services, Contractor shall give seven (7) calendar days written notice to the Owner before suspending services. In the event of a suspension, and prior to Contractor resuming performance, Owner shall pay the Contractor all sums due prior to suspension, and for increases in the cost of performance and expenses incurred by Contractor in demobilization and remobilization, if any. In the event of any suspension hereunder, the Contractor shall have no liability to the Owner for delay, damages or increases in the cost of the Work resulting from such suspension. The Contract Time and Contractor's fee for the remaining services shall be equitably adjusted by change order. If Contractor elects to terminate the Agreement, Contractor shall provide the Owner with notice pursuant to '9.4 of the Agreement. Upon termination, the Contractor shall be entitled to recover from the Owner payment of the balance of Contractor's fee for the entire Project, and any costs associated with the enforcement of the Contractor's rights hereunder, including reasonable attorneys' fees.

39. §9.8.5 The second sentence shall read: "The Owner shall make payment of retainage."

40. §9.9.1 Add a new sentence at the end of the paragraph: "For any partial occupancy or use, the Owner shall reduce retainage proportionately to the Contractor at the time of partial occupancy or use."

41. §9.10.2 Delete the final sentence.

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

42. §10.3.1 In the second sentence delete "a hazardous material our substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from". In the same sentence delete "encountered on the site by the Contractor".

43. §10.3.3 In the last sentence, replace "fault or" with "gross" and after "negligence" add "or willful misconduct".

44. §10.3.4 In the last sentence, replace "fault or" with "gross" and after "negligence" add "or willful misconduct"

45. §10.3.6 In the first sentence delete ", without negligence on the part of the Contractor," and the word "solely". Add "including attorneys' fees and expenses" at the end of the sentence.

ARTICLE 11: INSURANCE AND BONDS

46. §11.1.1.5 Delete ", including loss of use resulting therefrom"

47. §11.1.4 After "(1) The Owner,", replace "the Architect and the Architect's consultants as additional insureds" with "as an additional insured".

48. §11.4.2 Delete paragraph.

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

49. §12.2.1 In the second sentence, delete "and compensation for the Architect's services and expenses made necessary thereby,". At the end of the paragraph add "In addition, the Owner shall promptly remedy damage and loss arising in conjunction with the Project caused in whole or in part by the Architect, any engineer hired by the Owner, and any other contractor under contract with the Owner, or anyone directly or indirectly employed by any of them, or anyone for whose acts they may be liable."

50. §12.2.2.1 In the third sentence, after "Owner waives the rights to", add "make a claim for breach of warranty and". In the same sentence after "correction by the Contractor" add a period and delete the rest of the sentence.

51. §12.2.5 Delete paragraph.

ARTICLE 13: MISCELLANEOUS PROVISIONS

52. §13.2.2 After "Contract Documents" add ",including those obligations incurred prior to the date of the assignment." Delete the last sentence.

53. Add new §13.2.3:

Contractor shall not be required to execute consents to facilitate assignment to a lender unless Contractor has been paid in full for all amounts due through the date of the assignment.

54. §13.7 In the first sentence, insert a period after the word "law" and delete the rest of the sentence.

55. Add new §13.8:

The Owner shall not institute any claim or action (directly or in the form of a third-party claim) against the Contractor, unless the Owner first obtains a written certificate, executed by an independent Contractor, architect, engineer, or appropriate professional licensed in the State of Delaware, other than the Initial Decision Maker, specifying and certifying that the acts or omissions of the Contractor that the Owner contends constitute a violation of the standard of care governing a Contractor performing services under similar circumstances. Failure of the Owner to obtain such a certification shall bar any action against the Contractor.

ARTICLE 14: TERMINATION OR SUSPENSION OF THE CONTRACT

56. §14.1.1 In the first sentence delete "through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor" .

57. §14.1.2 Delete the word "repeated" and replace "120" with "90".

58. §14.2.1 In subparagraph .1 and subparagraph .3, replace "repeatedly" with "persistently".

59. §14.2.2 In the first sentence insert the word "written" after the word "upon" and before the word "certification".

60. §14.2.2.1 Delete everything after "site"

61. §14.2.2.3 In the first sentence insert "and Initial Decision Maker" after "Owner".

62. Add new §14.4.4:

A termination by the Owner for cause later determined to be wrongful or unjustified shall not be converted to a termination for convenience but shall be considered a material breach of the Agreement by the Owner. Contractor shall be entitled to damages, as appropriate, arising from such breach as determined by applicable law.

ARTICLE 15: CLAIMS AND DISPUTES

63. §15.1.2 Delete paragraph.

64. §15.1.5.1 Delete the second sentence.

65. §15.1.5.2 Delete "could not have been reasonably anticipated".

66. Add new §15.1.7:

Consequential damages include, but are not limited to, loss of use, loss of income, lost or additional rent, lost or additional financing (including increased or extended finance charges), loss of business and reputation, principal office expenses including the compensation of personnel stationed there and lost profits, except Contractor's anticipated fees arising directly from the Work.

67. §15.2.1 In the first sentence, after "Decision Maker for" delete "initial". In the second sentence, after "Paragraph 15.2.1," delete "an initial" and insert "a" and after "decision" insert "by the Initial Decision Maker".

68. §15.2.2 Delete paragraph.

69. §15.2.3 Delete paragraph.

70. §15.2.4 Delete paragraph.

71. 15.2.6 Delete "an initial" and replace with "a" and insert "by the Initial Decision Maker" before "at any time".

72. §15.2.6.1 Delete paragraph.

73. §15.2.7 Delete paragraph.

74. §15.3.3 In the second sentence, after "mediation shall be" insert "in writing and".

75. §15.4.1 Delete the last sentence.

76. Add the following at the end of §15.4.2:

Any award rendered shall include the prevailing party's costs, which shall include attorneys' fees, arbitration fees, filing fees, witness and experts' fees. If the monetary award is less than that sought by the prevailing party, then the award for costs shall be in an amount which is proportionate to the award for the claim. Any award of punitive damages is expressly prohibited.

77. §15.4.4.1 In subheading (2), replace "common" with "related". In subheading (3) replace "materially" with "reasonably".

SECTION 006113 – PERFORMANCE AND PAYMENT BONDS

1. PERFORMANCE AND PAYMENT BONDS

1.1 Bonds must be in the following form:

1. Form of Performance Bond (attached).
2. Form of Payment Bond (attached).

SECTION 00 61 13 - FORM OF PAYMENT BOND

Bond Number:

KNOW ALL PERSONS BY THESE PRESENTS, that we, _____, as principal ("Principal"), and _____, a _____ corporation, legally authorized to do business in the State of Delaware, as surety ("Surety"), are held and firmly bound unto the State of Delaware, Delaware Technical Community College ("Owner"), in the amount of _____ ($_____), to be paid to Owner, for which payment well and truly to be made, we do bind ourselves, our and each and every of our heirs, executors, administrations, successors and assigns, jointly and severally, for and in the whole firmly by these presents.

Sealed with our seals and dated this _____ day of_____, 20____.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH, that if Principal, who has been awarded by Owner that certain contract known as Contract No. _____dated the _____ day of _____, 20__ (the "Contract"), which Contract is incorporated herein by reference, shall well and truly pay all and every person furnishing materials or performing labor or service in and about the performance of the work under the Contract, all and every sums of money due him. her, them or any of them, for all such materials, labor and service for which Principal is liable, shall make good and reimburse Owner sufficient funds to pay such costs in the completion of the Contract as Owner may sustain by reason of any failure or default on the part of Principal, and shall also indemnity and save harmless Owner from all costs, damages and expenses arising out of or by reason of the performance of the Contract and for as long as provided by the Contract; then this obligation shall be void, otherwise to be and remain in full force and effect.

Surety, for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of Surety and its bond shall be in no way impaired or affected by any extension of time, modification, omission, addition or change in or to the Contract or the work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or by any assignment, subletting or other transfer thereof or of any work to be performed or any monies due or to become due thereunder; and Surety hereby waives notice of any and all such extensions, modifications, omissions, additions, changes, payments, waivers, things done and omitted to be done by and in relation to assignees, subcontractors, and other transferees shall have the same effect as to Surety as though done or omitted to be done by or in relation to Principal.

Surety hereby stipulates and agrees that no modifications, omission or additions in or to the terms of the Contract shall in any way whatsoever affect the obligation of Surety and its bond. Any proceeding, legal or equitable, under this Bond may be brought in any court of competent jurisdiction in the State of Delaware. Notices to Surety or Contractor may be mailed or delivered to them at their respective addresses shown below.

IN WITNESS WHEREOF, Principal and Surety have hereunto set their hand and seals, and such of them as are corporations have caused their corporate seal to be hereto affixed and these presents to be signed by their duly authorized officers, the day and year first above written.

PRINCIPAL

Name: _____

Witness or Attest: Address: _____

By:_____(SEAL)
Name: Name:
Title:

(Corporate Seal)

SURETY

Name: _____

Witness or Attest: Address: _____

By: _____(SEAL)
Name: Name:
Title:

(Corporate Seal)

SECTION 00 61 13 - FORM OF PERFORMANCE BOND

Bond Number: _____

KNOW ALL PERSONS BY THESE PRESENTS, that we, _____, as principal ("Principal"), and _____, a _____ corporation, legally authorized to do business in the State of Delaware, as surety ("Surety"), are held and firmly bound unto the State of Delaware, Delaware Technical Community College ("Owner"), in the amount of_____ ($_____) to be paid to Owner, for which payment well and truly to be made, we do bind ourselves, our and each and every of our heirs, executors, administrations, successors and assigns. jointly and severally, for and in the whole, firmly by these presents.

Sealed with our seals and dated this _____ day of _____, 20_____.

NOW THE CONDITION OF THIS OBLICATION IS SUCH, that if Principal, who has been awarded by Owner that certain contract known as Contract No. _____ dated the _____ day of _____, 20 (the "Contract"), which Contract is incorporated herein by reference, shall well and truly provide and furnish all materials, appliances and tools and perform all the work required under and pursuant to the terms and conditions of the Contract and the Contract Documents (as defined in the Contract) or any changes or modifications thereto made as therein provided, shall make good and reimburse Owner sufficient funds to pay the costs of completing the Contract that Owner may sustain by reason of any failure or default on the part of Principal, and shall also indemnify and save harmless Owner from all costs, damages and expenses arising out of or by reason of the performance of the Contract and for as long as provided by the Contract; then this obligation shall be void, otherwise to be and remain in full force and effect.

Surety, for value received, hereby stipulates and agrees, if requested to do so by Owner, to fully perform and complete the work to be performed under the Contract pursuant to the terms, conditions and covenants thereof, if for any cause Principal fails or neglects to so fully perform and complete such work

Surety, for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of Surety and its bond shall be in no way impaired or affected by any extension of time, modification, omission, addition or change in or to the Contract or the work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or by any assignment, subleting or other transfer thereof or of any work to be performed or any monies due or to become due thereunder; and Surety hereby waives notice of any and all such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers and hereby expressly stipulates and agrees that any and all things done and omitted to be done by and in relation to assignees, subcontractors, and other transferees shall have the same effect as to Surety as though done or omitted to be done by or in relation to Principal.

Surety hereby stipulates and agrees that no modifications, omissions or additions in or to the terms of the Contract shall in any way whatsoever affect the obligation of Surety and its bond.

Any proceeding, legal or equitable, under this Bond may be brought in any court of competent jurisdiction in the State of Delaware. Notices to Surety or Contractor may be mailed or delivered to them at their respective addresses shown below.

IN WITNESS WHEREOF, Principal and Surety have hereunto set their hand and seals, and such of them as are corporations have caused their corporate seal to be hereto affixed and these presents to be signed by their duly authorized officers, the day and year first above written.

PRINCIPAL

Name: _____

Witness or Attest: Address: _____

By:_____(SEAL)
Name:
Name:
Title:

(Corporate Seal)

SURETY

Name: _____

Witness or Attest: Address: _____

By: _____(SEAL)
Name:
Name:
Title:

(Corporate Seal)

END OF SECTION

SECTION 006216 – CERTIFICATE OF INSURANCE

In conjunction with Insurance Requirements AIA General Conditions, Article 11, the Contractor shall be bound by the following limits of liability insurance (for Contracts under this Bid Pac). The Contractor shall use the standard "ACCORD" for titled "Certificate of Insurance" in submitting his liability insurance limits. The required limits to be inserted in accordance with the sample "ACCORD" form in this section:

GENERAL NOTES

1. Other Insurance

   1.1 Contractor shall carry any necessary insurance required to cover Owned and Rental equipment that may be necessary for them to use in the performance of the Work.

2. Contractor shall have the following additional items added to his required "ACCORD" form Certificate of Insurance:

   1. Name and Address of Insured (Contractor).
   2. Description of Operations/Locations -

3. Added Insured – Delaware Technical Community College and EDiS Company

4. Certificate Holder – Delaware Technical Community College
   Terry Campus
   100 Campus Drive
   Dover, De 19903

Contractors shall note that although not a part of AIA Document A232 - 2009 Edition, these additional articles apply as noted to this Project.

A sample certificate is bound into the Project Manual immediately following this Document.

END OF SECTION

SECTION 006216 – CERTIFICATE OF INSURANCE

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3. Added Insured – Delaware Technical Community College and EDiS Company

4. Certificate Holder – Delaware Technical Community College
   Terry Campus
   100 Campus Drive
   Dover, De 19903

Contractors shall note that although not a part of AIA Document A232 - 2009 Edition, these additional articles apply as noted to this Project.

A sample certificate is bound into the Project Manual immediately following this Document.

END OF SECTION

ACORD™ CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YY) XX/XX/XX

PRODUCER

PRODUCER INSURANCE AGENCY
PO BOX
PRODUCER STREET ADDRESS
PRODUCER CITY, ST PROD ZIP

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

INSURERS AFFORDING COVERAGE

INSURED

SAMPLE SUBCONTRACTOR CERTIFICATE
(REQUIRED MINIMUM INSURANCE)

INSURER A: XXXXXX
INSURED B XXXXXX
INSURER C: XXXXXX
INSURER D:
INSURER E:

COVERAGES

THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. AGGREGATE LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	DATE (MM/YY)	LIMITS	
	GENERAL LIABILITY	XXXXXXXXXXXXXXX	XXXXXXXX	XXXXXXXXXX	EACH OCCURRENCE	$ 1,000,000
	X COMMERCIAL GENERAL LIABILITY				FIRE DAMAGE (Any one fire)	$ 300,000
	CLAIMS MADE X OCCUR				MED EXP (Any one person)	$ 10,000
					PERSONAL & ADV INJURY	$ 1,000,000
					GENERAL AGGREGATE	$ 2,000,000
	GENL AGGREGATE LIMIT APPLIES PER:				PRODUCTS - COMP/OP AGG	$ 2,000,000
	POLICY X PRO-JECT LOC					
	AUTOMOBILE LIABILITY	XXXXXXXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	COMBINED SINGLE LIMIT (Ea accident)	$ 1,000,000
	X ANY AUTO					
	ALL OWNED AUTOS				BODILY INJURY (Per person)	$
	SCHEDULED AUTOS					
	X HIREDAUTOS				BODILY INJURY (Per accident)	$
	X NON-OWNED AUTOS					
					PROPERTY DAMAGE (Per accident)	$
	GARAGE LIABILITY				AUTO ONLY - EA ACCIDENT	$
	ANY AUTO				OTHER THAN: AUTO ONLY: EA ACC	$
					AGG	$
	EXCESS LIABILITY	XXXXXXXXXXXXXXX	XXXXXXXXXXX	XXXXXXX	EACH OCCURRENCE	$ 5,000,000
	X OCCUR CLAIMS MADE				AGGREGATE	$ 5,000,000
						$
	DEDUCTIBLE					$
	RETENTION $					$
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY	XXXXXXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXX	X WC STATU-TORY LIMITS / OTH-ER	$
					E.L. EACH ACCIDENT	$ 500,000
					E.L. DISEASE - EA EMPLOYEE	$ 500,000
					E.L. DISEASE - POLICY LIMIT	$ 500,000
	OTHER					

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/EXCLUSIONS ADDED BY ENDORSEMENT/SPECIAL PROVISIONS

Name of Project: Delaware Technical Community College Office of the President - Delaware Technical Community College and EDiS Company shall be named as Additional Insureds for both ongoing and completed operations. The endorsements providing the Additional Insured status for ongoing and completed operations must be attached to the Certificate of Insurance.

CERTIFICATE HOLDER X ADDITIONAL INSURED; INSURER LETTER: ——— CANCELLATION

Delaware Technical Community College
Terry Campus
100 Campus Drive
Dover, De 19903

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING INSURER WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, BUT FAILURE TO DO SO SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE INSURER, ITS AGENTS OR REPRESENTATIVES.

AUTHORIZED REPRESENTATIVE

© ACORD CORPORATION 1988

SECTION 007200 – GENERAL CONDITIONS

1. SUMMARY

1.1. The General Conditions for this Project are the American Institute of Architects General Conditions of the Contract for Construction, Construction Manager as Advisor Edition, AIA Document A201 - 2007 Edition.

1.2 A copy of AIA Document A201 - 2007 Edition is bound into this Project Manual following this page.

END OF SECTION

DRAFT

AIA® Document A201™ – 2007

General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)
Central Administration Building Expansion and Renovation
100 Campus Drive
Dover, De 19903

THE OWNER:
(Name, legal status and address)
Delaware Technical Community College
Terry Campus
100 Campus Drive
Dover De 19903

THE ARCHITECT:
(Name, legal status and address)
Becker Morgan Group
Port Exchange, Suite 300
312 West Main Street
Salisbury, MD 21801

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 BASIC DEFINITIONS

§ 1.1.1 THE CONTRACT DOCUMENTS

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding requirements.

§ 1.1.2 THE CONTRACT

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 THE WORK

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 THE PROJECT

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by separate contractors.

§ 1.1.5 THE DRAWINGS

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules and diagrams.

§ 1.1.6 THE SPECIFICATIONS

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 INSTRUMENTS OF SERVICE

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 INITIAL DECISION MAKER

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2 and certify termination of the Agreement under Section 14.2.2.

§ 1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

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§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 CAPITALIZATION

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 INTERPRETATION

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and will retain all common law, statutory and other reserved rights, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce the Instruments of Service provided to them solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers may not use the Instruments of Service on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and the Architect's consultants.

§ 1.6 TRANSMISSION OF DATA IN DIGITAL FORM

If the parties intend to transmit Instruments of Service or any other information or documentation in digital form, they shall endeavor to establish necessary protocols governing such transmissions, unless otherwise already provided in the Agreement or the Contract Documents.

ARTICLE 2 OWNER

§ 2.1 GENERAL

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

§ 2.2.1 Prior to commencement of the Work, the Contractor may request in writing that the Owner provide reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. Thereafter, the Contractor may only request such evidence if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) a change in the Work materially changes the Contract Sum; or (3) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due. The Owner shall furnish such evidence as a condition precedent to commencement or continuation of the Work or

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the portion of the Work affected by a material change. After the Owner furnishes the evidence, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.2 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.2.3 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.2.4 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.2.5 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.3 OWNER'S RIGHT TO STOP THE WORK

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.4 OWNER'S RIGHT TO CARRY OUT THE WORK

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

ARTICLE 3 CONTRACTOR

§ 3.1 GENERAL

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

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§ 3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.2.3, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall make Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to the Owner and Architect and shall not proceed with that portion of the Work without further written instructions from the Architect. If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Owner shall be solely responsible for any loss or damage arising solely from those Owner-required means, methods, techniques, sequences or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 LABOR AND MATERIALS

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other

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facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work authorized by the Architect in accordance with Sections 3.12.8 or 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 WARRANTY

The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.6 TAXES

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 PERMITS, FEES, NOTICES AND COMPLIANCE WITH LAWS

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions. If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 21 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor in writing, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may proceed as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume

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the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 ALLOWANCES

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- **.1** Allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- **.2** Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- **.3** Whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 SUPERINTENDENT

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the name and qualifications of a proposed superintendent. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to the proposed superintendent or (2) that the Architect requires additional time to review. Failure of the Architect to reply within the 14 day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 CONTRACTOR'S CONSTRUCTION SCHEDULES

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall prepare and submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work.

§ 3.10.2 The Contractor shall prepare a submittal schedule, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Architect's approval. The Architect's approval shall not unreasonably be delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

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§ 3.11 DOCUMENTS AND SAMPLES AT THE SITE

The Contractor shall maintain at the site for the Owner one copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and one copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect and shall be delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. Their purpose is to demonstrate the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve and submit to the Architect Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect in writing of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such written notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be

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required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review, approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

§ 3.13 USE OF SITE

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 CUTTING AND PATCHING

§ 3.14.1 The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting and patching shall be restored to the condition existing prior to the cutting, fitting and patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

§ 3.15 CLEANING UP

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 ACCESS TO WORK

The Contractor shall provide the Owner and Architect access to the Work in preparation and progress wherever located.

§ 3.17 ROYALTIES, PATENTS AND COPYRIGHTS

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications or other documents prepared by the Owner or Architect. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect.

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§ 3.18 INDEMNIFICATION

§ 3.18.1 To the fullest extent permitted by law the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

ARTICLE 4 ARCHITECT

§ 4.1 GENERAL

§ 4.1.1 The Owner shall retain an architect lawfully licensed to practice architecture or an entity lawfully practicing architecture in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 4.1.2 Duties, responsibilities and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner, Contractor and Architect. Consent shall not be unreasonably withheld.

§ 4.1.3 If the employment of the Architect is terminated, the Owner shall employ a successor architect as to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 4.2 ADMINISTRATION OF THE CONTRACT

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for, the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents, except as provided in Section 3.3.1.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and report to the Owner (1) known deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor, and (2) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

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§ 4.2.4 COMMUNICATIONS FACILITATING CONTRACT ADMINISTRATION
Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Architect about matters arising out of or relating to the Contract. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.5.2 and 13.5.3, whether or not such Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5 and 3.12. The Architect's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect, of any construction means, methods, techniques, sequences or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may authorize minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more project representatives to assist in carrying out the Architect's responsibilities at the site. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in an exhibit to be incorporated in the Contract Documents.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

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§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 DEFINITIONS

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a separate contractor or subcontractors of a separate contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

§ 5.2.1 Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to any such proposed person or entity or (2) that the Architect requires additional time for review. Failure of the Owner or Architect to reply within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person or entity previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 SUBCONTRACTUAL RELATIONS

By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, which the Contractor, by these Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may

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be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 CONTINGENT ASSIGNMENT OF SUBCONTRACTS

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- **.1** assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor in writing; and
- **.2** assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon such assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

§ 6.1.1 The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Article 15.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to the construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces, the Owner shall be deemed to be subject to the same obligations and to have the same rights that apply to the Contractor under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6 and Articles 10, 11 and 12.

§ 6.2 MUTUAL RESPONSIBILITY

§ 6.2.1 The Contractor shall afford the Owner and separate contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Architect apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that

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the Owner's or separate contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a separate contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a separate contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or separate contractors as provided in Section 10.2.5.

§ 6.2.5 The Owner and each separate contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 OWNER'S RIGHT TO CLEAN UP

If a dispute arises among the Contractor, separate contractors and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 GENERAL

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor and Architect; a Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor; an order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive or order for a minor change in the Work.

§ 7.2 CHANGE ORDERS

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor and Architect stating their agreement upon all of the following:

- **.1** The change in the Work;
- **.2** The amount of the adjustment, if any, in the Contract Sum; and
- **.3** The extent of the adjustment, if any, in the Contract Time.

§ 7.3 CONSTRUCTION CHANGE DIRECTIVES

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- **.1** Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- **.2** Unit prices stated in the Contract Documents or subsequently agreed upon;
- **.3** Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or

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.4 As provided in Section 7.3.7.

§ 7.3.4 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed in a proposed Change Order or Construction Change Directive so that application of such unit prices to quantities of Work proposed will cause substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 7.3.5 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.6 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.7 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the method and the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.7 shall be limited to the following:

.1 Costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance;

.2 Costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;

.3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;

.4 Costs of premiums for all bonds and insurance, permit fees, and sales, use or similar taxes related to the Work; and

.5 Additional costs of supervision and field office personnel directly attributable to the change.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 MINOR CHANGES IN THE WORK

The Architect has authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes will be effected by written order signed by the Architect and shall be binding on the Owner and Contractor.

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ARTICLE 8 TIME

§ 8.1 DEFINITIONS

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 PROGRESS AND COMPLETION

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the effective date of insurance required by Article 11 to be furnished by the Contractor and Owner. The date of commencement of the Work shall not be changed by the effective date of such insurance.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 DELAYS AND EXTENSIONS OF TIME

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner or Architect, or of an employee of either, or of a separate contractor employed by the Owner; or by changes ordered in the Work; or by labor disputes, fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor's control; or by delay authorized by the Owner pending mediation and arbitration; or by other causes that the Architect determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 CONTRACT SUM

The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.2 SCHEDULE OF VALUES

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit to the Architect, before the first Application for Payment, a schedule of values allocating the entire Contract Sum to the various portions of the Work and prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 9.3 APPLICATIONS FOR PAYMENT

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. Such application shall be notarized, if required, and supported by such data substantiating the Contractor's right to payment as the Owner or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and shall reflect retainage if provided for in the Contract Documents.

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§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or material supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage and transportation to the site for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

§ 9.4 CERTIFICATES FOR PAYMENT

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect's reasons for withholding certification in whole or in part as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data comprising the Application for Payment, that, to the best of the Architect's knowledge, information and belief, the Work has progressed to the point indicated and that the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Architect. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment, or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 DECISIONS TO WITHHOLD CERTIFICATION

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- **.1** defective Work not remedied;
- **.2** third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the Owner is provided by the Contractor;

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.3 failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;
.4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
.5 damage to the Owner or a separate contractor;
.6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
.7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.3 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or material or equipment suppliers to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Architect will reflect such payment on the next Certificate for Payment.

§ 9.6 PROGRESS PAYMENTS

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor no later than seven days after receipt of payment from the Owner the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and material and equipment suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor, except as may otherwise be required by law.

§ 9.6.5 Contractor payments to material and equipment suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors and suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.7 FAILURE OF PAYMENT

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' written notice to the Owner and Architect,

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stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shut-down, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 SUBSTANTIAL COMPLETION

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the Owner shall make payment of retainage applying to such Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 PARTIAL OCCUPANCY OR USE

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer as required under Section 11.3.1.5 and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 FINAL COMPLETION AND FINAL PAYMENT

§ 9.10.1 Upon receipt of the Contractor's written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection and, when the

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Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner, (3) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment and (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- **.1** liens, Claims, security interests or encumbrances arising out of the Contract and unsettled;
- **.2** failure of the Work to comply with the requirements of the Contract Documents; or
- **.3** terms of special warranties required by the Contract Documents.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 SAFETY PRECAUTIONS AND PROGRAMS

The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 SAFETY OF PERSONS AND PROPERTY

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to

- **.1** employees on the Work and other persons who may be affected thereby;
- **.2** the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor's Subcontractors or Sub-subcontractors; and
- **.3** other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

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§ 10.2.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss.

§ 10.2.3 The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent sites and utilities.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3, except damage or loss attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 INJURY OR DAMAGE TO PERSON OR PROPERTY
If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 HAZARDOUS MATERIALS
§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and report the condition to the Owner and Architect in writing.

§ 10.3.2 Upon receipt of the Contractor's written notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of such material or substance or who are to perform the task of removal or safe containment of such material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased in the amount of the Contractor's reasonable additional costs of shut-down, delay and start-up.

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§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall indemnify the Owner for the cost and expense the Owner incurs (1) for remediation of a material or substance the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall indemnify the Contractor for all cost and expense thereby incurred.

§ 10.4 EMERGENCIES

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 CONTRACTOR'S LIABILITY INSURANCE

§ 11.1.1 The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations and completed operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

- **.1** Claims under workers' compensation, disability benefit and other similar employee benefit acts that are applicable to the Work to be performed;
- **.2** Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;
- **.3** Claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;
- **.4** Claims for damages insured by usual personal injury liability coverage;
- **.5** Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom;
- **.6** Claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;
- **.7** Claims for bodily injury or property damage arising out of completed operations; and
- **.8** Claims involving contractual liability insurance applicable to the Contractor's obligations under Section 3.18.

§ 11.1.2 The insurance required by Section 11.1.1 shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from the date of commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment, and, with respect to the Contractor's completed operations coverage, until the expiration of the period for correction

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of Work or for such other period for maintenance of completed operations coverage as specified in the Contract Documents.

§ 11.1.3 Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work and thereafter upon renewal or replacement of each required policy of insurance. These certificates and the insurance policies required by this Section 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment as required by Section 9.10.2 and thereafter upon renewal or replacement of such coverage until the expiration of the time required by Section 11.1.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness.

§ 11.1.4 The Contractor shall cause the commercial liability coverage required by the Contract Documents to include (1) the Owner, the Architect and the Architect's consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations.

§ 11.2 OWNER'S LIABILITY INSURANCE

The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

§ 11.3 PROPERTY INSURANCE

§ 11.3.1 Unless otherwise provided, the Owner shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance written on a builder's risk "all-risk" or equivalent policy form in the amount of the initial Contract Sum, plus value of subsequent Contract Modifications and cost of materials supplied or installed by others, comprising total value for the entire Project at the site on a replacement cost basis without optional deductibles. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 11.3 to be covered, whichever is later. This insurance shall include interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Project.

§ 11.3.1.1 Property insurance shall be on an "all-risk" or equivalent policy form and shall include, without limitation, insurance against the perils of fire (with extended coverage) and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, falsework, testing and startup, temporary buildings and debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for Architect's and Contractor's services and expenses required as a result of such insured loss.

§ 11.3.1.2 If the Owner does not intend to purchase such property insurance required by the Contract and with all of the coverages in the amount described above, the Owner shall so inform the Contractor in writing prior to commencement of the Work. The Contractor may then effect insurance that will protect the interests of the Contractor, Subcontractors and Sub-subcontractors in the Work, and by appropriate Change Order the cost thereof shall be charged to the Owner. If the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain insurance as described above, without so notifying the Contractor in writing, then the Owner shall bear all reasonable costs properly attributable thereto.

§ 11.3.1.3 If the property insurance requires deductibles, the Owner shall pay costs not covered because of such deductibles.

§ 11.3.1.4 This property insurance shall cover portions of the Work stored off the site, and also portions of the Work in transit.

§ 11.3.1.5 Partial occupancy or use in accordance with Section 9.9 shall not commence until the insurance company or companies providing property insurance have consented to such partial occupancy or use by endorsement or

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otherwise. The Owner and the Contractor shall take reasonable steps to obtain consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse or reduction of insurance.

§ 11.3.2 BOILER AND MACHINERY INSURANCE
The Owner shall purchase and maintain boiler and machinery insurance required by the Contract Documents or by law, which shall specifically cover such insured objects during installation and until final acceptance by the Owner; this insurance shall include interests of the Owner, Contractor, Subcontractors and Sub-subcontractors in the Work, and the Owner and Contractor shall be named insureds.

§ 11.3.3 LOSS OF USE INSURANCE
The Owner, at the Owner's option, may purchase and maintain such insurance as will insure the Owner against loss of use of the Owner's property due to fire or other hazards, however caused. The Owner waives all rights of action against the Contractor for loss of use of the Owner's property, including consequential losses due to fire or other hazards however caused.

§ 11.3.4 If the Contractor requests in writing that insurance for risks other than those described herein or other special causes of loss be included in the property insurance policy, the Owner shall, if possible, include such insurance, and the cost thereof shall be charged to the Contractor by appropriate Change Order.

§ 11.3.5 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, the Owner shall waive all rights in accordance with the terms of Section 11.3.7 for damages caused by fire or other causes of loss covered by this separate property insurance. All separate policies shall provide this waiver of subrogation by endorsement or otherwise.

§ 11.3.6 Before an exposure to loss may occur, the Owner shall file with the Contractor a copy of each policy that includes insurance coverages required by this Section 11.3. Each policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to this Project. Each policy shall contain a provision that the policy will not be canceled or allowed to expire, and that its limits will not be reduced, until at least 30 days' prior written notice has been given to the Contractor.

§ 11.3.7 WAIVERS OF SUBROGATION
The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents and employees, each of the other, and (2) the Architect, Architect's consultants, separate contractors described in Article 6, if any, and any of their subcontractors, sub-subcontractors, agents and employees, for damages caused by fire or other causes of loss to the extent covered by property insurance obtained pursuant to this Section 11.3 or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by the Owner as fiduciary. The Owner or Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described in Article 6, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

§ 11.3.8 A loss insured under the Owner's property insurance shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.3.10. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner.

§ 11.3.9 If required in writing by a party in interest, the Owner as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Owner's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Owner shall deposit in a separate account proceeds so received, which the

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Owner shall distribute in accordance with such agreement as the parties in interest may reach, or as determined in accordance with the method of binding dispute resolution selected in the Agreement between the Owner and Contractor. If after such loss no other special agreement is made and unless the Owner terminates the Contract for convenience, replacement of damaged property shall be performed by the Contractor after notification of a Change in the Work in accordance with Article 7.

§ 11.3.10 The Owner as fiduciary shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within five days after occurrence of loss to the Owner's exercise of this power; if such objection is made, the dispute shall be resolved in the manner selected by the Owner and Contractor as the method of binding dispute resolution in the Agreement. If the Owner and Contractor have selected arbitration as the method of binding dispute resolution, the Owner as fiduciary shall make settlement with insurers or, in the case of a dispute over distribution of insurance proceeds, in accordance with the directions of the arbitrators.

§ 11.4 PERFORMANCE BOND AND PAYMENT BOND

§ 11.4.1 The Owner shall have the right to require the Contractor to furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract.

§ 11.4.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 UNCOVERING OF WORK

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner's expense. If such Work is not in accordance with the Contract Documents, such costs and the cost of correction shall be at the Contractor's expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

§ 12.2 CORRECTION OF WORK

§ 12.2.1 BEFORE OR AFTER SUBSTANTIAL COMPLETION

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, whether discovered before or after Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 AFTER SUBSTANTIAL COMPLETION

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.4.

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§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of the Owner or separate contractors caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 ACCEPTANCE OF NONCONFORMING WORK

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 GOVERNING LAW

The Contract shall be governed by the law of the place where the Project is located except that, if the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 SUCCESSORS AND ASSIGNS

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to covenants, agreements and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make such an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate such assignment.

§ 13.3 WRITTEN NOTICE

Written notice shall be deemed to have been duly served if delivered in person to the individual, to a member of the firm or entity, or to an officer of the corporation for which it was intended; or if delivered at, or sent by registered or certified mail or by courier service providing proof of delivery to, the last business address known to the party giving notice.

§ 13.4 RIGHTS AND REMEDIES

§ 13.4.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law.

§ 13.4.2 No action or failure to act by the Owner, Architect or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach there under, except as may be specifically agreed in writing.

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§ 13.5 TESTS AND INSPECTIONS

§ 13.5.1 Tests, inspections and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of (1) tests, inspections or approvals that do not become requirements until after bids are received or negotiations concluded, and (2) tests, inspections or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor.

§ 13.5.2 If the Architect, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Section 13.5.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.5.3, shall be at the Owner's expense.

§ 13.5.3 If such procedures for testing, inspection or approval under Sections 13.5.1 and 13.5.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure including those of repeated procedures and compensation for the Architect's services and expenses shall be at the Contractor's expense.

§ 13.5.4 Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.5.5 If the Architect is to observe tests, inspections or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.5.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.6 INTEREST

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at such rate as the parties may agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

§ 13.7 TIME LIMITS ON CLAIMS

The Owner and Contractor shall commence all claims and causes of action, whether in contract, tort, breach of warranty or otherwise, against the other arising out of or related to the Contract in accordance with the requirements of the final dispute resolution method selected in the Agreement within the time period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all claims and causes of action not commenced in accordance with this Section 13.7.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 TERMINATION BY THE CONTRACTOR

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:

- **.1** Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- **.2** An act of government, such as a declaration of national emergency that requires all Work to be stopped;

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.3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or

.4 The Owner has failed to furnish to the Contractor promptly, upon the Contractor's request, reasonable evidence as required by Section 2.2.1.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, repeated suspensions, delays or interruptions of the entire Work by the Owner as described in Section 14.3 constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, including reasonable overhead and profit, costs incurred by reason of such termination, and damages.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' written notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 TERMINATION BY THE OWNER FOR CAUSE

§ 14.2.1 The Owner may terminate the Contract if the Contractor

.1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;

.2 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;

.3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or

.4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the above reasons exist, the Owner, upon certification by the Initial Decision Maker that sufficient cause exists to justify such action, may without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

.1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

.2 Accept assignment of subcontracts pursuant to Section 5.4; and

.3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 SUSPENSION BY THE OWNER FOR CONVENIENCE

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work in whole or in part for such period of time as the Owner may determine.

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§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay or interruption as described in Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

- **.1** that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or
- **.2** that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of written notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- **.1** cease operations as directed by the Owner in the notice;
- **.2** take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- **.3** except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment for Work executed, and costs incurred by reason of such termination, along with reasonable overhead and profit on the Work not executed.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 CLAIMS

§ 15.1.1 DEFINITION

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim.

§ 15.1.2 NOTICE OF CLAIMS

Claims by either the Owner or Contractor must be initiated by written notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party must be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3 CONTINUING CONTRACT PERFORMANCE

Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents. The Architect will prepare Change Orders and issue Certificates for Payment in accordance with the decisions of the Initial Decision Maker.

§ 15.1.4 CLAIMS FOR ADDITIONAL COST

If the Contractor wishes to make a Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.5 CLAIMS FOR ADDITIONAL TIME

§ 15.1.5.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, written notice as provided herein shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.5.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated and had an adverse effect on the scheduled construction.

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§ 15.1.6 CLAIMS FOR CONSEQUENTIAL DAMAGES
The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- **.1** damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- **.2** damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.6 shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 INITIAL DECISION
§ 15.2.1 Claims, excluding those arising under Sections 10.3, 10.4, 11.3.9, and 11.3.10, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim arising prior to the date final payment is due, unless 30 days have passed after the Claim has been referred to the Initial Decision Maker with no decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of such request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of an initial decision, demand in writing that the other party file for mediation within 60 days of the initial decision. If such a demand is made and the party receiving the demand fails to file for mediation within the time required, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

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§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 MEDIATION

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.6 shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 ARBITRATION

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 CONSOLIDATION OR JOINDER

§ 15.4.4.1 Either party, at its sole discretion, may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Either party, at its sole discretion, may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an

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additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as the Owner and Contractor under this Agreement.

DRAFT

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SUPPLEMENTARY CONDITIONS TO AIA A201-2007

These Supplementary Conditions dated _____ modify the AIA Document A201 - 2007 General Conditions of the Contract for Construction ("General Conditions"), for use with the Standard Form of Agreement between Owner and Contractor (the "Agreement") by and between EDiS Company ("Contractor") and _____ ("Owner").

ARTICLE 1: GENERAL PROVISIONS

1. §1.1.2 Delete the last sentence.

2. §1.1.3 Delete "whether completed or partially completed…"from the first sentence.

ARTICLE 2: OWNER

3. §2.1.1 Insert a period after the word "matters" in the second sentence and delete the rest of the sentence.

4. §2.2.1 Insert "and from time to time thereafter" after the word "Work" and before the word "the" in the first line of the paragraph. Delete the second sentence. In the third sentence add a period after "continuation of the Work" and delete the remainder of the sentence. In the fourth sentence, delete the word "materially".

5. §2.3 In the second line, replace "repeatedly" with "persistently and willfully".

6. §2.4 In the second sentence, delete the words "Owner's expenses and".

ARTICLE 3: CONTRACTOR

7. §3.2.1 Insert a period after the word "performed" and delete the rest of the sentence.

8. §3.2.2 In the first sentence delete "Because the Contract Documents are complementary,". In the second line replace the words "carefully study and compare" with "review". In the second sentence, delete the words "coordination and" and "or made known to".

9. §3.2.4 At the end of the paragraph, replace the period with a comma and add "unless the Contractor recognized such error, inconsistency, omission, difference, or non-conformity and knowingly failed to report it.

10. §3.3.1 In the last sentence, add the word "resulting" after the word "any" and before the word "loss". Insert a period after the word "damage" and delete the remainder of the sentence.

11. §3.5 In the first sentence, delete "and Architect" and "of good quality and". In the second sentence replace "defective" with "nonconforming". At the end of the paragraph add "Other than above, the Contractor makes no other warranty, representation, or guarantee, whether express or implied and such are expressly disclaimed."

12. §3.7.5 In the first sentence, add the word "knowingly" after the word "Contractor" and before the word "encounters".

13. §3.12.6 In the first sentence, delete "and Architect". At the end of the paragraph add "The Contractor is relying on the Architect's having fully coordinated the design drawings in making the above representation."

14. §3.12.10 In the first sentence insert a period after "…Contract Documents" and delete the remainder of the sentence. In the third sentence, delete "related to systems, materials or equipment".

15. Add new §3.18.3:

The Owner shall indemnify and hold the Contractor and the Contractor's officers and employees harmless from and against damages, losses and judgments arising from claims by third parties, including reasonable attorneys' fees and expenses recoverable under applicable law, but only to the extent they are caused by the negligent acts or omissions of the Owner, its employees or anyone for whom Owner is responsible

ARTICLE 4: ARCHITECT

16. §4.2.1 Delete the words "and will be an Owner's representative" from the sentence.

17. §4.2.7 In the first sentence, insert a period after the word "Samples" and delete the rest of the sentence. In the second sentence, insert "as to cause no delay in the Work, or in the activities of the Contractor or Owner," after the word "promptness" and before the word "while".

ARTICLE 5: SUBCONTRACTORS

18. §5.2.1 In the first sentence, delete the words "through the Architect". In the second sentence, start with "The Owner" and delete "Architect" and delete "or the Architect" after "(1)" and replace "Architect" with "Owner" after "(2)". In the last sentence, delete "or Architect".

19. §5.2.4 Delete paragraph.

20. §5.3 In the first sentence, delete "and Architect". In the second sentence, delete "and Architect". In the fourth sentence delete "prior to the execution of the subcontract agreement,". In the fourth sentence insert a period after the word "bound" and delete the remainder of the sentence.

ARTICLE 6: CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

21. §6.1.3 At the end of the second sentence add "when directed to do so." In the third sentence, add "and Contract Sum" after the word "schedule" and before the word "deemed".

22. §6.2.2 In the first sentence, replace the word "apparent" with the word "known".

23. §6.2.3 Delete paragraph.

ARTICLE 7: CHANGES TO THE WORK

24. §7.3.3 Delete "If" at the beginning of the first sentence. Insert the word "shall" after the word "Directive" and before the word "provides". Change "provides" to "provide".

25. §7.3.7 After subparagraph .5, add a new paragraph that reads: "The Architect's determination, as specified above, shall not be less than the actual costs expended by the Contractor in performing the changed Work. If the Architect's determination is believed by the Contractor to be less than its actual costs (incurred or projected) in performing the Work, the Contractor may initiate dispute resolution pursuant to Article 15."

26. §7.4 Replace "Architect" with "Owner" wherever it appears in this paragraph.

ARTICLE 8: TIME

27. §8.1.3 Replace "certified by the Architect" with "as established".

28. §8.2.1 Delete the second sentence.

29. §8.3.1 In the first sentence delete "by an act or neglect of the Owner or Architect, or of any employee of either, or of a separate contractor employed by the Owner; or by changes ordered in the Work; or".

ARTICLE 9: PAYMENTS AND COMPLETION

30. §9.3.1 In the second sentence insert the word "reasonably" after the word "may" and before the word "require" Insert a period after "require" and delete the remainder of the sentence.

31. §9.3.1.2 Delete paragraph.

32. §9.3.2 At the beginning of the second sentence, delete "If approved in advance by the Owner,". In the last sentence, delete "applicable insurance,".

33. §9.4.2 In the first sentence, delete "to the best of the Architect's knowledge, information and belief,".

34. §9.5.1 In the fourth sentence delete "or, because of subsequently discovered evidence, may nullify the whole or part of a Certificate for Payment previously issued". In subparagraph .2, delete "or reasonable evidence indicating probable filing of such claims". In subparagraph .3, delete "properly". In subparagraph .7, replace "repeated" with "persistent".

35. §9.5.3 Delete and replace with the following:

Owner may not withhold payment, pursue any claim for penalty, damages, offset or backcharge and such claim shall be deemed waived unless Contractor was given written advance notice of the deficiency by the Owner, was allowed reasonable time to correct the deficiency, and failed to do so.

36. §9.6.3 Delete paragraph.

37. §9.6.4 Delete the second sentence.

38. §9.7 Delete and replace with the following:

Contractor may suspend performance under this Agreement if at any time any payment, reimbursement or costs are due and outstanding for a period of more than forty-five (45) calendar days from the date of any application for payment, such failure of payment shall represent material nonperformance by the Owner and cause for termination of the Agreement, or, at the Contractor's option, cause for suspension of performance of all services under the Agreement. If the Contractor elects to suspend services, Contractor shall give seven (7) calendar days written notice to the Owner before suspending services. In the event of a suspension, and prior to Contractor resuming performance, Owner shall pay the Contractor all sums due prior to suspension, and for increases in the cost of performance and expenses incurred by Contractor in demobilization and remobilization, if any. In the event of any suspension hereunder, the Contractor shall have no liability to the Owner for delay, damages or increases in the cost of the Work resulting from such suspension. The Contract Time and Contractor's fee for the remaining services shall be equitably adjusted by change order. If Contractor elects to terminate the Agreement, Contractor shall provide the Owner with notice pursuant to '9.4 of the Agreement. Upon termination, the Contractor shall be entitled to recover from the Owner payment of the balance of Contractor's fee for the entire Project, and any costs associated with the enforcement of the Contractor's rights hereunder, including reasonable attorneys' fees.

39. §9.8.5 The second sentence shall read: "The Owner shall make payment of retainage."

40. §9.9.1 Add a new sentence at the end of the paragraph: "For any partial occupancy or use, the Owner shall reduce retainage proportionately to the Contractor at the time of partial occupancy or use."

41. §9.10.2 Delete the final sentence.

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

42. §10.3.1 In the second sentence delete "a hazardous material our substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from". In the same sentence delete "encountered on the site by the Contractor".

43. §10.3.3 In the last sentence, replace "fault or" with "gross" and after "negligence" add "or willful misconduct".

44. §10.3.4 In the last sentence, replace "fault or" with "gross" and after "negligence" add "or willful misconduct"

45. §10.3.6 In the first sentence delete ", without negligence on the part of the Contractor," and the word "solely". Add "including attorneys' fees and expenses" at the end of the sentence.

ARTICLE 11: INSURANCE AND BONDS

46. §11.1.1.5 Delete ", including loss of use resulting therefrom"

47. §11.1.4 After "(1) The Owner,", replace "the Architect and the Architect's consultants as additional insureds" with "as an additional insured".

48. §11.4.2 Delete paragraph.

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

49. §12.2.1 In the second sentence, delete "and compensation for the Architect's services and expenses made necessary thereby,". At the end of the paragraph add "In addition, the Owner shall promptly remedy damage and loss arising in conjunction with the Project caused in whole or in part by the Architect, any engineer hired by the Owner, and any other contractor under contract with the Owner, or anyone directly or indirectly employed by any of them, or anyone for whose acts they may be liable."

50. §12.2.2.1 In the third sentence, after "Owner waives the rights to", add "make a claim for breach of warranty and". In the same sentence after "correction by the Contractor" add a period and delete the rest of the sentence.

51. §12.2.5 Delete paragraph.

ARTICLE 13: MISCELLANEOUS PROVISIONS

52. §13.2.2 After "Contract Documents" add ",including those obligations incurred prior to the date of the assignment." Delete the last sentence.

53. Add new §13.2.3:

Contractor shall not be required to execute consents to facilitate assignment to a lender unless Contractor has been paid in full for all amounts due through the date of the assignment.

54. §13.7 In the first sentence, insert a period after the word "law" and delete the rest of the sentence.

55. Add new §13.8:

The Owner shall not institute any claim or action (directly or in the form of a third-party claim) against the Contractor, unless the Owner first obtains a written certificate, executed by an independent Contractor, architect, engineer, or appropriate professional licensed in the State of Delaware, other than the Initial Decision Maker, specifying and certifying that the acts or omissions of the Contractor that the Owner contends constitute a violation of the standard of care governing a Contractor performing services under similar circumstances. Failure of the Owner to obtain such a certification shall bar any action against the Contractor.

ARTICLE 14: TERMINATION OR SUSPENSION OF THE CONTRACT

56. §14.1.1 In the first sentence delete "through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor" .

57. §14.1.2 Delete the word "repeated" and replace "120" with "90".

58. §14.2.1 In subparagraph .1 and subparagraph .3, replace "repeatedly" with "persistently".

59. §14.2.2 In the first sentence insert the word "written" after the word "upon" and before the word "certification".

60. §14.2.2.1 Delete everything after "site"

61. §14.2.2.3 In the first sentence insert "and Initial Decision Maker" after "Owner".

62. Add new §14.4.4:

A termination by the Owner for cause later determined to be wrongful or unjustified shall not be converted to a termination for convenience but shall be considered a material breach of the Agreement by the Owner. Contractor shall be entitled to damages, as appropriate, arising from such breach as determined by applicable law.

ARTICLE 15: CLAIMS AND DISPUTES

63. §15.1.2 Delete paragraph.

64. §15.1.5.1 Delete the second sentence.

65. §15.1.5.2 Delete "could not have been reasonably anticipated".

66. Add new §15.1.7:

Consequential damages include, but are not limited to, loss of use, loss of income, lost or additional rent, lost or additional financing (including increased or extended finance charges), loss of business and reputation, principal office expenses including the compensation of personnel stationed there and lost profits, except Contractor's anticipated fees arising directly from the Work.

67. §15.2.1 In the first sentence, after "Decision Maker for" delete "initial". In the second sentence, after "Paragraph 15.2.1," delete "an initial" and insert "a" and after "decision" insert "by the Initial Decision Maker".

68. §15.2.2 Delete paragraph.

69. §15.2.3 Delete paragraph.

70. §15.2.4 Delete paragraph.

71. 15.2.6 Delete "an initial" and replace with "a" and insert "by the Initial Decision Maker" before "at any time".

72. §15.2.6.1 Delete paragraph.

73. §15.2.7 Delete paragraph.

74. §15.3.3 In the second sentence, after "mediation shall be" insert "in writing and".

75. §15.4.1 Delete the last sentence.

76. Add the following at the end of §15.4.2:

Any award rendered shall include the prevailing party's costs, which shall include attorneys' fees, arbitration fees, filing fees, witness and experts' fees. If the monetary award is less than that sought by the prevailing party, then the award for costs shall be in an amount which is proportionate to the award for the claim. Any award of punitive damages is expressly prohibited.

77. §15.4.4.1 In subheading (2), replace "common" with "related". In subheading (3) replace "materially" with "reasonably".

SECTION 007300 - SUPPLEMENTARY CONDITIONS

1. GENERAL CONDITIONS

1.1. The General Conditions of the Contract for Construction, AIA Document A201-2007 Edition, Articles 1 through 15 inclusive, is a part of this contract and is bound herewith.

1.2 References to Articles herein are to Articles in A201-2007 Edition.

2. SUPPLEMENTARY CONDITIONS

2.1 The following provisions modify, change, delete from or add to AIA Document A201-2007 Edition. Where any article of the General Conditions is modified or any paragraph, subparagraph or clause thereof is modified or deleted by these provisions, the unaltered provisions of that article, paragraph, sub-paragraph or clause shall remain in effect.

3. REFERENCE TO DIVISION 1 - GENERAL REQUIREMENTS

3.1 Certain provisions of Division 1 GENERAL REQUIREMENTS supplement the administrative and work-related provisions of the GENERAL CONDITIONS.

3.2 Articles affected are cross referenced in the various Sections of Division 1.

3.3 ARTICLE 1 - GENERAL PROVISIONS

A. Delete the third sentence in paragraph 1.1.1

B. Sub-paragraph 1.1.1 The Contract Documents: Add the following sentence:

"The Contract Documents also include Advertisement for Bid, Instructions to Bidder, sample forms, the Bid Form, the Contractor's completed Bid and the Award Letter."

C. Add the following subparagraph:

1.1.9 Terms and Definitions

The following definitions apply to the terms listed below as used on the Drawings and in the Project Manual:

Provide: Furnish and Install

Approved: Approved by Architect or authority enforcing standards

Described: Refer to Project Manual

Specified: Refer to Project Manual

Shown: Refer to Drawings

D. Add the following subparagraph:

1.5.3 The Contractor will be furnished free of charge up to three (3) sets of the Drawings and Project Manual. Additional sets will be furnished at the cost of reproduction, postage, and handling.

3.4 ARTICLE 2 – OWNER

A. To Subparagraph 2.2.2 – Add the following sentence:

"The Contractor, at their expense shall bear the costs to accurately identify the location of all underground utilities in the area of their excavation and shall bear all costs for any repairs required, out of failure to accurately identify said utilities."

B. Delete Subparagraph 2.2.5 in its entirety and substitute the following:

2.2.5 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor three (3) sets of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2. Additional sets will be furnished at the cost of reproduction, postage, and handling.

3.5 ARTICLE 3 – CONTRACTOR

A. Paragraph 3.1 – General, Sub-paragraph 3.1.1: Add the following sentences:

"This definition applies to each Contractor having an agreement with the Owner."

"The duties and obligations of the Contract apply to this Contractor (as defined herein) regardless of similar or identical duties or obligations of other Prime Contracts related to the Project. Therefore, even though other Prime Contractors may have similar, identical or overlapping duties and obligations, each and every duty and obligation set forth in this Contract is enforceable against this Contractor."

B. Add the following Paragraphs:

3.3.2.1 The Contractor shall immediately remove from the Work, whenever requested to do so by the Owner, any person who is considered by the Owner or Architect to be incompetent or disposed to be so disorderly,

or who for any reason is not satisfactory to the Owner, and that person shall not again be employed on the Work without the consent of the Owner or Architect.

C. Paragraph 3.4 - Labor and Materials:

Add the following Paragraphs:

3.4.4 The Contractor must provide suitable storage facilities at the Site for the proper protection and safe storage of their materials. Consult the Owner and the Architect before storing any materials.

3.4.5 When any room is used as a shop, storeroom, office, etc., by the Contractor or Subcontractor(s) during the construction of the Work, the Contractor making use of these areas will be held responsible for any repairs, patching or cleaning arising from such use.

3.4.6 Refer to Division 1 for detailed requirements concerning Temporary Facilities and Equipment.

3.4.7 Before starting the Work, each Contractor shall carefully examine all preparatory Work that has been executed to receive their Work. Check carefully, by whatever means are required, to insure that its Work and adjacent, related Work, will finish to proper contours, planes and levels. Promptly notify the General Contractor/Construction Manager of any defects or imperfections in preparatory Work which will in any way affect satisfactory completion of its Work. Absence of such notification will be construed as an acceptance of preparatory Work and later claims of defects or requests for adjustment of the Contract Sum will be denied.

3.4.8 Under no circumstances shall the Contractor's Work proceed prior to preparatory Work having been completely cured, dried and/or otherwise made satisfactory to receive this Work. Responsibility for timely installation of all materials rests solely with the Contractor responsible for the Work, who shall maintain coordination at all times.

F. Paragraph 3.5 - Warranty:

Add the following Paragraphs:

3.5.1 The Contractor will guarantee all materials and workmanship against original defects, except injury from proper and usual wear when used for the purpose intended, for one year after Acceptance by the Owner, and will maintain all items in perfect condition during the period of guarantee.

3.5.2 Defects appearing during the period of guarantee will be made good by the Contractor, at his sole expense, upon demand of the Owner, it being required that all work will be in perfect condition when the period of guarantee will have elapsed.

3.5.3 In addition to the General Guarantee there are other guarantees required for certain items for different periods of time than the one year above, and are particularly so stated in the part of the specifications referring to same. The said guarantees will commence at the same time as the General Guarantee.

3.5.4 If the Contractor fails to remedy any failure, defect or damage within a reasonable time after receipt of notice, the Owner will have the right to replace, repair or otherwise remedy the failure, defect or damage at the Contractor's expense.

G. Paragraph 3.7 - Permits, Fees, Notices, and Compliance with Laws

Add the following subparagraphs:

3.7.6 Where the local law at the site of the building requires a Certificate of Occupancy, the Construction Manager shall obtain and pay for this Certificate through the Owner and deliver it to the Owner.

3.7.7 The general building permit for all components of the entire project will be obtained from the applicable authority and paid for by the Owner through the Construction Manager.

H. Paragraph 3.12 - Shop Drawings, Product Data and Samples

Add the following subparagraph:

3.12.11 Refer to Section 013300, SUBMITTAL PROCEDURES, for detailed requirements.

I. Paragraph 3.15 - Cleaning Up

Add the following subparagraph:

3.15.3 Refer to Section 011100, SUMMARY OF WORK, for detailed requirements.

3.6 ARTICLE 4 – ARCHITECT AND CONSTRUCTION MANAGER

A. Paragraph 4.1 – General, Sub-paragraph 4.1.1: Add the following sentence:

"The Architect will have no full-time project representative on this project."

3.7 ARTICLE 5 - SUBCONTRACTORS

A. Paragraph 5.2 - Awards of Subcontracts and Other Contracts for Portions of the Work, Sub-paragraph 5.2.3: Add the following to the end of the first sentence:

", subject to the statutory requirements of 29 Delaware Code 6962(d)(10)b.3,4."

B. Add the following subparagraph:

5.2.5 Delaware State law provisions concerning naming and use of Subcontractors supersede any foregoing provisions of Paragraph 5.2 where such provisions are in conflict with Delaware State Law. Refer to provisions in Section 002113 INSTRUCTIONS TO BIDDERS.

3.8 ARTICLE 6 - CONSTRUCTION BY OWNER OR BY OTHER CONTRACTORS

A. Paragraph 6.1 - Owner's Right to Perform Construction with Own Forces and to Award Other Contracts

Add the following subparagraph:

6.1.4 Refer to Section 011100, SUMMARY OF WORK, for detailed requirements.

3.9 ARTICLE 7 - CHANGES IN THE WORK

A. Paragraph 7.2 - Change Orders

Add the following subparagraphs:

7.2.4 See Section 01 26 00, CHANGE ORDER PROCEDURES, for detailed requirements.

7.2.5 In the event that work is performed under the provisions of paragraph 7.3.3, the Owner will reimburse the Contractor for all costs directly incurred in the performance of the Work, plus overhead and profit as follows: Costs shall include the cost of materials including sales tax and cost of delivery; cost of labor, including social security, old age and unemployment insurance, and fringe benefits required by agreement or custom; bond premiums, rental value of power tools, equipment and machinery. Overhead shall include the following: supervision, superintendent, wages of time keepers, watchmen and clerks, hand tools, incidentals, general office expense, and all other expenses not included in "cost". All such overhead shall be directly attributable to the change. As applied to Change Orders, overhead and profit shall be as follows:

1. For extra work performed by the Contractor with his own forces, 10% for overhead and 5% for profit.

2. For work done by a subcontractor, 10% for overhead and 5% for profit to which the Contractor may add an additional 7.5% for his overhead and profit combined.

3. For work deleted by a Change Order or where reductions in costs are involved, no item for overhead or profit shall be included in the computation. Change Orders shall have additions and deductions figured separately without overhead and profit added. The smaller amount shall then be deducted from the larger to determine the net value of the change. If the net results in an addition to the Contract Sum, the above overhead and profit items shall be added to the net increase only.

3.10 ARTICLE 8 - TIME

A. Paragraph 8.2 - Progress and Completion

Delete subparagraph 8.2.3 in its entirety and substitute the following:

8.2.3 Refer to Section 011100 SUMMARY OF WORK and Section 01 32 16 CONSTRUCTION PROGRESS SCHEDULE, for detailed requirements. Work shall commence immediately upon the Contractors receipt of a letter of intent from the Construction Manager.

B. Add the following subparagraphs:

8.2.4 The Contractor guarantees and warrants that there will be sufficient tradesmen on the job each day to ensure that there will be no interruption of work. If the Construction Manager in his sole discretion decides that the work and the progress of the job has been impeded because of the Contractor's inability to supply tradesmen for the job, the Construction Manager may terminate the contract with forty-eight (48) hours notice. [COORDINATE THIS WITH THE TERMINATION CLAUSE. ARTICLE 14.2.2 STATES THERE WILL BE A 7 DAY WRITTEN NOTICE BY THE OWNER.]

8.2.5 If the Work falls behind Progress Schedule as submitted by the Contractor, the Contractor shall employ additional labor and/or equipment necessary to bring the Work into compliance with the Progress Schedule at no additional cost to the Owner.

B. Paragraph 8.3 – Delays and Extensions of Time

Add the following subparagraph:

8.3.2.1 The Contractor shall update the status of the suspension, delay or interruption of the Work with each Application for Payment. (The Contractor shall report the termination of such cause immediately upon the termination thereof.) Failure to comply with this procedure shall constitute a waiver for any claim for adjustment of time or price based upon said cause.

Delete Paragraph 8.3.3 in its entirety and replace with the following:

8.3.3 Except in the case of a suspension of the Work directed by the Owner, an extension of time under the provisions of Paragraph 8.3.1 shall be the Contractor's sole remedy in the progress of the Work and there shall be no payment or compensation to the Contractor for any expense or damage resulting from the delay.

Add the following Paragraph:

8.3.4 By permitting the Contractor to work after the expired time for completion of the project, the Owner does not waive its rights under the Contract.

3.11 ARTICLE 9 - PAYMENTS AND COMPLETION

A. Paragraph 9.2 - Schedule of Values

Add the following sentence to subparagraph 9.2.1:

"Refer to Section 013300, SUBMITTAL PROCEDURES, for submittal requirements."

Add the following subparagraphs:

9.2.2 The Schedule of Values shall be submitted using AIA Document G703, Continuation Sheet to G702/CMa.

9.2.3 The Schedule of Values is to include a line item for Project Closeout Document Submittal. The value of this item is to be no less than 3.5% of the initial contract amount.

B. Paragraph 9.3 - Applications for Payment

Add the following Subparagraph:

9.3.4 Until Closeout Documents have been received and outstanding items completed, the Owner will pay 95% (ninety-five percent) of the amount due the Contractor on account of progress payments.

C. Paragraph 9.5 – Decisions to Withhold Certification

Add the following to Subparagraph 9.5.1:

.8 failure to provide a current Progress Schedule;
.9 a lien or attachment is filed;
.10 failure to comply with mandatory requirements for maintaining Record Documents.

D. Paragraph 9.6 - Progress Payments

Delete subparagraph 9.6.1 in its entirety and replace with the following:

9.6.1 After the Architect has approved and issued a Certificate for Payment, payment shall be made by the Owner within 30 days after Owner's receipt of the Certificate of Payment.

3.12 ARTICLE 10 – PROTECTION OF PERSONS AND PROPERTY

A. 10.1 SAFETY PRECAUTIONS AND PROGRAMS

Add the following Subparagraphs:

10.1.1 Contractor shall develop a safety program in accordance with the Occupational Safety and Health Act of 1970. A copy of said plan shall be furnished to the Owner and Architect prior to the commencement of that Contractor's Work.

10.1.2 Contractor shall appoint a Safety Representative. Safety Representatives shall be someone who is on site on a full time bases. If deemed necessary by the Owner or Architect, Contractor Safety meetings will be scheduled. The attendance of all Safety Representatives will be required. Minutes will be recorded of said meeting by the Contractor and will be distributed to all parties as well as posted in all job offices/trailers etc.

3.13 ARTICLE 11 – INSURANCE AND BONDS

A. Paragraph 11.1 – Contractor's Liability Insurance

Subparagraph 11.1.1: Make the following change:

11.1.1 In the first line following DELETE the phrase "lawfully authorized to do business in the jurisdiction in which the Project is located" and INSERT the phrase "licensed to do business in the state of Delaware".

B. Subparagraph 11.1.2: Delete entirely and insert the following:

11.1.2 "The insurance required by subparagraph 11.1.1 shall be written for not less than the following or as required by law, whichever is greater.

In conjunction with Insurance Requirements AIA General Conditions, Article 11, the Contractor shall be bound by the following limits of liability insurance (for contracts under this bid pac). The Contractor shall use the standard "ACORD" form titled "Certificate of Insurance" in submitting his liability insurance limits. The required limits to be inserted in the "ACORD" form are as follows:

The Contractor shall purchase and maintain at all times throughout the term of this Agreement without interruption and, at the least, from the date of the commencement of the Work until the date of final payment or the date insurance coverage is required to be maintained after final payment to the Contractor under this Agreement, whichever is later, the following insurance coverages (with the specified limits of liability) and shall provide to the Construction Manager the complete policies for such insurance coverages upon the request of the Construction Manager:

11.1.2.1 Commercial General Liability ("CGL") coverage with limits of not less than $1,000,000 each occurrence and $2,000,000 in the "annual aggregate".

11.1.2.1.1 If the CGL coverage contains a "General Aggregate Limit", such General Aggregate Limit shall apply separately to each project of the Contractor, specifically including this Project.

11.1.2.1.2 CGL coverage shall be written on ISO Occurrence Form CG 00 011093, or a substitute form providing equivalent coverage and shall cover liability arising from premises, operations, independent contractors, product-completed operations and personal and advertising injury.

11.1.2.1.3 EDiS Company, Owner and all other parties required by EDiS Company shall be included as additional insureds on the CGL using Additional Insured Endorsements that provide coverage for both ongoing and completed operations. The insurance for the additional insureds shall be as broad as the coverage provided for the named insured Contractor. The CGL coverage shall apply as Primary and non-contributory insurance before any other insurance or self-insurance, including any deductible, maintained by, or provided to, any additional insured other than the other insurances coverages purchased and maintained by the Contractor hereunder.

11.1.2.1.4 Contractor shall maintain CGL coverage for itself and all additional insured for the duration of the Project and maintain Completed Operations coverage for itself and each additional insureds for at least three (3) years after completion of the Work, using Additional Insured Endorsements that provide Completed Operations Coverage.

11.1.2.2. Business Automobile Liability ("BAL") coverage with combined single limits of at least $1,000,000 (per occurrence).

11.1.2.2.1 BAL coverage must include coverage for liability arising out of all owned, leased, hired and non-owned automobiles.

11.1.2.2.2 BAL coverage shall be written on an occurrence basis.

11.1.2.2.3 Construction Manager, Owner and all other parties required by the Construction Manager shall be included as additional insureds on the BAL coverage. The insurance for the additional insureds shall be as broad as the coverage provided for the named insured Contractor. The BAL coverage shall apply as Primary and non-contributory insurance before any other insurance or self-insurance, including any deductible, maintained by, or provided to, any additional insured other than the other insurances coverages purchased and maintained by the Contractor hereunder.

11.1.2.3. Commercial Umbrella ("CU") coverage with limits of at least $5,000,000.

11.1.2.3.1 CU coverage shall be written on an occurrence basis.

11.1.2.3.2 Construction Manager, Owner and all other parties required by the Construction Manager shall be included as additional insureds on the CU coverage for both ongoing and Completed Operations. The insurance for the additional insureds shall be as broad as the coverage provided for the named insured Contractor. The CU coverage shall apply as Primary and non-contributory insurance before any other insurance or self-insurance, including any deductible, maintained by, or provided to, any additional insured other than the other insurances coverages purchased and maintained by the Contractor hereunder.

11.1.2.4 Workers' Compensation shall be maintained to protect against claims under the workers' compensation act with limits of at least $500,000 for each accident. Employers' Liability coverage will also be maintained with limits of at least $500,000 for each accident for bodily injury including death and disease.

11.1.2.4.1 WCEL coverage shall be written on an occurrence basis.

11.1.2.4.2 Where applicable and/or as required by the construction manager, the U.S. Longshoremen and Harborworkers' Compensation Act endorsement shall be included as part of the WCEL coverage and attached to the policy for WCEL coverage.

11.1.2.4.3 Where applicable and/or as required by the Construction Manager, the Maritime Coverage Endorsement shall be included as part of the WCEL coverage and attached to the policy for WCEL coverage.

11.1.2.5 The Contractor shall provide property insurance necessary for the protection against loss of owned, rented or borrowed capital equipment and tools, including tools owned by employees, and any tools, equipment staging towers and forms owned, rented or borrowed by the Subcontractor. The property insurance shall include a Waiver of Subrogation in favor of all parties required to be named as Additional Insureds under the Contract Documents. Contractor shall ensure that any subcontractor employed by him similarly carries sufficient insurance to protect that subcontractor's property.

11.1.2.6 Contractor waives all rights against the Construction Manager, Owner and all their agents, officers, directors and employees for recovery of damages to the extent those damages are covered by any of the insurance coverages purchased and maintained by the Contractor.

11.1.2.7 Contractor shall provide the Construction Manager with appropriate certificates of insurance coverages evidencing that the insurance coverages required herein are valid and in full force and effect at least thirty (30) days before the Contractor performs any Work and before the Contractor or any of its agents, subcontractors or employees enters upon the job site. Each such certificate of insurance and the actual insurance policy for each insurance coverage required herein shall contain a provision that the coverage and protection afforded under the policy will not be canceled or modified or allowed to expire without at least thirty (30) days' prior written notice to the Construction Manager.

11.1.2.8 Each policy of insurance coverage purchased and maintained by the Contractor herein shall be so purchased and maintained from or by an insurance company properly and fully authorized and licensed to do business and to issue policies of insurance in the state in which the Project is located.

11.1.2.9 Each policy of insurance coverage purchased and maintained by the Contractor herein shall provide that the insurer shall defend any suit or action against the Construction Manager and/or Owner and their agents, officers, directors and employees and hold them harmless, even if such suit or action is frivolous or fraudulent. Such policy also shall provide the Construction Manager and Owner the right to engage their/its own attorney(s) for the purpose of defending any legal action against the Construction Manager and/or Owner and their agents, officers, directors and employees, and that the Contractor shall indemnify and hold harmless the Construction Manager or Owner, and their agents, officers,

directors and employees, for costs and expenses, including attorney's fees, arising out of or incurred in defending such suit or action.

11.1.2.10 The purchase, maintenance or issuance of insurance coverage of any type by the Contractor or the Construction Manager or Owner as required herein or otherwise, shall not be deemed or construed to release, limit, waive or discharge the Contractor from any or all of the obligations and risks imposed by the Agreement upon the Contractor. Neither shall any forbearance nor omission by the Construction Manager to require proof of insurance coverages or certificates of insurance or to obtain or review any policies of insurance coverage from the Contractor before permitting the Contractor to proceed or continue with the Work be deemed a waiver of the Construction Manager's rights or the Contractor's obligations regarding the provision of insurance coverage under this Agreement.

11.1.2.11 Waiver of Subrogation. Subcontractor hereby waives any and all rights of recovery against the Construction Manager, Owner and their respective officers, members, agents, employees, and insurance companies occurring on or arising out of Contractor's Work to the extent such loss or damage is covered by proceeds received from insurance required under this Agreement to be carried by the Contractor.

11.1.2.12 Contractor hereby certifies that it has furnished to its insurance provider(s) a copy or copies of the foregoing insurance requirements (all the applicable requirements of Section 9. hereof) ("requirements"), and Contractor, for and on behalf of itself and its insurance provider(s), certifies and agrees that all insurance coverages (including but not limited to the types, limits, periods of coverage, endorsements and policies applicable or in regard thereto) provided to the Construction Manager hereunder are in accordance and full compliance with the requirements, as reasonably determined and interpreted by the Construction Manager. Contractor, to the fullest extent permitted by applicable law, shall defend, indemnify and save harmless the Construction Manager, Owner and their respective successors, assigns, directors, officers, agents and employees from and against any and all damages and losses, without limitation, including attorneys' fees and costs caused by, arising out of or resulting from the Contractor or its insurance provider(s) refusal or failure to provide all the insurance coverages (including but not limited to the types, limits, periods of coverage, endorsements and policies applicable or in regard thereto) required hereunder, to comply in any respect with the requirements, and/or to fully honor and abide by any of the certifications and/or agreements set forth in this section.

3.14 ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

A. Paragraph 12.2 – Correction of Work

Add the following Subparagraph to 12.2.2:

12.2.2.4 At any time during the progress of the Work, or in any case where the nature of the defects will be such that it is not expedient to have the defects corrected, the Owner, at its option, will have the right to deduct such sum, or sums, of money from the amount of the Contract as it considers justified to adjust the difference in value between the defective work and that required under contract including any damage to the structure.

3.15 ARTICLE 13: MISCELLANEOUS PROVISIONS

A. Add the following Paragraph:

13.8 Conflicts with Federal Statutes or Regulations

13.8.1 If any provision, specifications or requirement of the Contract Documents conflict or is inconsistent with any statute, law or regulation of the government of the United States of America, the Contract shall notify the Architect and Owner immediately upon discovery.

Add the following Articles and Paragraphs:

3.17 ARTICLE 16 - PREFERENCE FOR DELAWARE LABOR (NEW ARTICLE)

16.1 The Contractor shall comply with the following provisions of Delaware Code, Title 29, Chapter 69, Section 6910:

In the construction of all public works for the State or any political subdivision or by persons contracting with the State or any political subdivision thereof, preference in employment of laborers, workmen or mechanics, shall be given to bona fide legal citizens of the State who have established citizenship by residence of at least 90 days in the State. Each public works contract for the construction of public works for the State or any political subdivision thereof shall contain a stipulation that any person, company, or corporation who violates this section shall pay a penalty to the Secretary of Finance equal to the amount of compensation paid to any person in violation of this section.

3.18 ARTICLE 17 - LICENSE AND TAX REQUIREMENTS (NEW ARTICLE)

17.1 Contractor and subcontractor shall be licensed to do business in the State of Delaware and shall pay all fees and taxes due under State laws. In conformance with Section 2503, Chapter 25, Title 30, Delaware Code, the Contractor shall furnish the State Tax Department, within 10 days after award of contract, a statement of the total values of each contract and subcontract, together with the names and addresses of the contracting parties. The Contractor, before the

payment of any award or amount payable to any Contractor or subcontractor not a resident of Delaware, shall ascertain from said non-resident Contractor or subcontractor and/or the State Tax Department, whether he has obtained a license and satisfied his liability paid by the non-resident Contractor or subcontractor, the Contractor shall deduct form the award the amount payable to said non-resident contractor or subcontractor the amount of said license liability and shall pay same to the State Tax Department within 10 days after final payment and settlement with the non-resident Contractor or subcontractor.

17.2 Taxes: The Contractor shall pay all sales, consumer, use and other taxes required by law.

3.19 ARTICLE 18 - PREVAILING DELAWARE WAGE RATES (NEW ARTICLE)

18.1 In accordance with Delaware Code, Title 29, Chapter 69, Section 6960, all laborers and mechanics of the Contractor and all subcontractors employed to perform work directly upon the site of the work shall be paid unconditionally and not less often than once a week and without subsequent deduction or rebate on any account the full amounts accrued at the time of payment computed at wage rates not less than those determined by the Division of Industrial Affairs, Department of Labor, State of Delaware, as the prevailing rates in this area.

18.2 This approved scale of wages must be posted by the Contractor in a prominent and easily accessible place at the site of the work.

18.3 It is further stipulated that there may be withheld from the Contractor such accrued payment as may be considered necessary by the contracting officer to pay laborers and mechanics employed by the Contractor or any subcontractors on the work the difference between the rates of wages required and the rate of wages received by such laborers and mechanics and not refunded to the Contractor, subcontractor or their agents.

18.4 Where wage rates are published in this Manual they are issued by the State Department of Labor on the date indicated and are included for the convenience of Bidders. The Owner, the Architect, and the Construction Manager, accept no responsibility for the accuracy or applicability of any rates included herein. The actual wage rate determinations which will apply to the work will be those in effect on the first day of public advertisement for bids as determined by the State Department of Labor. It will be the responsibility of each bidder to contact the State Department of Labor and to incorporate these rates in his bid.

18.5 "In accordance with Delaware Code, Title 29, Section 6960 as amended January 24, 2008, contractors shall furnish sworn payroll information to the Department of Labor on a weekly basis for each contract which exceeds $15,000 for renovation work and $100,000 for new construction. The construction contract amount is based on a cumulative total of all contracts bid for a specific project. Payroll forms for submission may be obtained from the Department of Labor."

18.5.1 A Payroll Report, available from the Department of Labor is to be used to provide this information.

END OF SECTION

SECTION 007343 – WAGE RATE REQUIREMENTS

1. SUMMARY

1.1. In accordance with Delaware Code, Title 29, Chapter 69, Section 6912, all laborers and mechanics of the Contractor and all subcontractors employed to perform work directly upon the site of the work shall be paid unconditionally and not less often than once a week and without subsequent deduction or rebate on any account the full amounts accrued at the time of payment computed at wage rates not less than those determined by the Division of Industrial Affairs, Department of Labor, State of Delaware, as the prevailing rates in this area.

1.2 This approved scale of wages must be posted by the Contractor in a prominent and easily accessible place at the site of the work.

1.3 It is further stipulated that there may be withheld from the Contractor such accrued payment as may be considered necessary by the contracting officer to pay laborers and mechanics employed by the Contractor or any subcontractors on the work the difference between the rates of wages required and the rate of wages received by such laborers and mechanics and not refunded to the Contractor, subcontractor or their agents.

1.4 Where wage rates are published in this Manual they are issued by the State Department of Labor on the date indicated and are included for the convenience of Bidders. The Owner, the Architect, and the Construction Manager, accept no responsibility for the accuracy or applicability of any rates included herein. The actual wage rate determinations which will apply to the work will be those in effect on the first day of public advertisement for bids as determined by the State Department of Labor. It will be the responsibility of each bidder to contact the State Department of Labor and to incorporate these rates in his bid.

1.5 "In accordance with Delaware Code, Title 29, Section 6912, as amended July 5, 1994, contractors shall furnish sworn payroll information to the Department of Labor on a weekly basis for each contract which exceeds $15,000 for renovation work and $100,000 for new construction. The construction contract amount is based on a cumulative total of all contracts bid for a specific project. Payroll forms for submission may be obtained from the Department of Labor."

1.5.1 A Payroll Report, available from the Department of Labor is to be used to provide this information.

1.6 A copy of the Prevailing Wages for the project is attached hereto.

END OF SECTION

STATE OF DELAWARE
DEPARTMENT OF LABOR
DIVISION OF INDUSTRIAL AFFAIRS
OFFICE OF LABOR LAW ENFORCEMENT
PHONE: (302) 451-3423

Mailing Address:
225 CORPORATE BOULEVARD
SUITE 104
NEWARK, DE 19702

Located at:
225 CORPORATE BOULEVARD
SUITE 104
NEWARK, DE 19702

PREVAILING WAGES FOR **BUILDING CONSTRUCTION** EFFECTIVE MARCH 15, 2012

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
ASBESTOS WORKERS	23.22	29.83	39.20
BOILERMAKERS	65.47	33.22	48.83
BRICKLAYERS	45.63	45.63	45.63
CARPENTERS	49.06	49.06	39.22
CEMENT FINISHERS	40.38	29.11	21.20
ELECTRICAL LINE WORKERS	43.49	37.29	28.44
ELECTRICIANS	59.10	59.10	59.10
ELEVATOR CONSTRUCTORS	73.14	40.93	30.55
GLAZIERS	62.60	62.60	54.20
INSULATORS	50.38	50.38	50.38
IRON WORKERS	58.70	58.70	58.70
LABORERS	37.20	37.20	37.20
MILLWRIGHTS	60.85	60.85	47.42
PAINTERS	40.62	40.62	40.62
PILEDRIVERS	66.42	37.64	30.45
PLASTERERS	21.61	21.61	17.50
PLUMBERS/PIPEFITTERS/STEAMFITTERS	57.95	43.24	46.28
POWER EQUIPMENT OPERATORS	55.81	55.81	24.13
ROOFERS-COMPOSITION	21.01	20.71	17.02
ROOFERS-SHINGLE/SLATE/TILE	17.59	17.50	16.45
SHEET METAL WORKERS	64.39	62.18	62.18
SOFT FLOOR LAYERS	44.92	44.92	44.92
SPRINKLER FITTERS	50.65	50.65	50.65
TERRAZZO/MARBLE/TILE FNRS	50.50	50.50	45.45
TERRAZZO/MARBLE/TILE STRS	57.98	57.98	52.63
TRUCK DRIVERS	22.49	23.80	20.03

CERTIFIED: 1/16/13 BY: _____
ADMINISTRATOR, OFFICE OF LABOR LAW ENFORCEMENT

NOTE: THESE RATES ARE PROMULGATED AND ENFORCED PURSUANT TO THE PREVAILING WAGE REGULATIONS ADOPTED BY THE DEPARTMENT OF LABOR ON APRIL 3, 1992.

CLASSIFICATIONS OF WORKERS ARE DETERMINED BY THE DEPARTMENT OF LABOR. FOR ASSISTANCE IN CLASSIFYING WORKERS, OR FOR A COPY OF THE REGULATIONS OR CLASSIFICATIONS, PHONE (302) 451-3423.

NON-REGISTERED APPRENTICES MUST BE PAID THE MECHANIC'S RATE.

PROJECT: Delaware Technical Community College - Central Administration Building, Kent County

SECTION 101100 - SUMMARY OF WORK

1. RELATED DOCUMENTS

1.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Sections, apply to work of this Section.

2. CONTRACTS

2.1 The work will be performed under separate prime contracts managed by the Construction Manager.

3. ALTERATIONS & COORDINATION

3.1 Contractor shall be responsible to coordinate their work with the work of others, including, but not limited to, the preparation of general coordination drawings, diagrams and schedules, and control of site utilization, from the beginning of activity, through project close-out and warranty periods.

4. KNOWLEDGE OF CONTRACT REQUIREMENTS

4.1 The Contractor and his Subcontractors, Sub-subcontractors and material men shall consult in detail the Contract Documents for instructions and requirements pertaining to the Work, and at his and their cost, shall provide all labor, materials, equipment and services necessary to furnish, install and complete the work in strict conformance with all provisions thereof.

4.2 The Contractor will be held to have examined the site of the Work prior to submitting his proposal and informed himself, his Subcontractors, Sub-subcontractors and material men of all existing conditions affecting the execution of the Work.

4.3 The Contractor will be held to have examined the Contract Documents and modifications thereto, as they may affect subdivisions of the Work and informed himself, his Subcontractors, Sub-subcontractors and material men of all conditions thereof affecting the execution of the Work.

4.4 The Scope of Work for the Contract is not necessarily limited to the description of each section of the Specifications and the illustrations shown on the Drawings. Include all minor items not expressly indicated in the Contract Documents, or as might be found necessary as a result of field conditions, in order to complete the Work as it is intended, without any gaps between the various subdivisions of work.

4.5 The Contractor will be held to be thoroughly familiar with all conditions affecting labor in the area of the Project including, but not limited to, Unions, incentive pay, procurements, living, parking and commuting conditions and to have informed his Subcontractors and

Sub-subcontractors thereof.

5. CONTRACT DOCUMENTS INFORMATION

5.1 The Contract Documents are prepared in accordance with available information as to existing conditions and locations. If, during construction, conditions are revealed at variance with the Contract Documents, notify the Construction Manager immediately, but no more than three (3) days from the day the variance is first known. Failure to give timely notice shall operate to waive any claim Contractor might otherwise have for an adjustment to Contract Time or Sum as a consequence of such variance.

5.2 The Specifications determine the kinds and methods of installation of the various materials, the Drawings establish the quantities, dimensions and details of materials, the schedules on the Drawings give the location, type and extent of the materials.

5.3 Dimensions given on the Drawings govern scale measurements and large scale drawings govern small scale drawings, except as to anything omitted unless such omission is expressly noted on the large scale drawings.

5.4 The techniques or methods of specifying to record requirements varies throughout text, and may include "prescriptive", "open generic/descriptive", "compliance with standards", "performance", "proprietary", or a combination of these. The methods used for specifying one unit of work has no bearing on requirements for another unit of work.

5.5 Whenever a material, article or piece of equipment is referred to in the singular number in the Contract Documents, it shall be the same as referring to it in the plural. As many such materials, articles or pieces of equipment shall be provided as are required to complete the Work.

5.6 Whenever a material, article or piece of equipment is specified by reference to a governmental, trade association of similar standard, it shall comply with the requirements of the latest publication thereof and amendments thereto in effect on the bid date.

5.7 In addition to the requirements of the Contract Documents, Contractor's work shall also comply with applicable standards of the construction industry and those industry standards are made a part of Contract Documents by reference, as if copied directly into Contract Documents, or as if published copies were bound herein.

5.8 Where compliance with two (2) or more industry standards, contract requirements, or sets of requirements is specified, and overlapping of those different standards or requirements establishes different or conflicting minimums or levels of quality, then the most stringent requirements, which are generally recognized to be also the most costly, is intended and will be enforced, unless specifically detailed language written into the Contract Documents clearly indicates that a less stringent requirement is to be fulfilled. Refer apparently equal but different requirements, and uncertainties as to which level of quality

is more stringent, to Architect for decision before proceeding.

5.9 Reference standards referenced directly in Contract Documents or by governing regulations have precedence over non-reference standards which are recognized in industry for applicability of work.

5.10 Contractor's bid is based on the complete set of Contract Documents including documents not specifically issued as part of the bid pack but referenced in same.

6. SCOPE OF WORK/GENERAL INFORMATION

6.1 A Scope of Work for each contract to be awarded on the project follows in this section. When a Contract has been awarded to a Contractor, the successful Contractor will be listed after the title of the Contract. When no Contract has yet been awarded, no Contractor's name will be listed. Previous Scopes of Work include addendum changes.

6.2 Contractor is responsible for performing the work listed in the Summary of Work for his contract. Contractor is also responsible for knowing the work that has been assigned to preceding contracts. No additional compensation or extension of time will be allowed a Contractor due to his ignorance of the work assigned to his Contract or to other contracts which may affect his work. The Contractor is responsible, however, for all items which are covered in the Specifications and Drawings relating to their Contract if not specifically mentioned in the Summary of Work.

6.3 The Construction Manager will provide on site a source for temporary electric, temporary water and portable sanitation facilities only. It is each Contractor's responsibility to make the necessary connections, including all material for temporary electric and water. Please note that utility charges for office trailers will be the responsibility of the individual Contractors.

6.4 A dumpster will be provided on site for free use by Contractors to dispose of non-hazardous, common, work-related refuse. Each type of material debris will be required to be separated for recycling purposes. Debris will be separated, at a minimum, by: metal, wood, masonry, concrete and general debris. Clean-up is the responsibility of each Contractor. Clean up shall be performed on a daily basis. Contractors not complying will be advised in writing and back charged for all costs associated with the clean up of their work.

6.5 Contractors are reminded that there are limited storage areas available on site. Off site storage will be the responsibility of each individual Contractor.

6.6 Office trailer permits off site will be the responsibility of each individual Contractor. On site Contractor's field offices, one (1) per Contractor, if required, will be located as directed by the Construction Manager.

6.7 Contractor will be prepared to discuss and submit a detailed project schedule seven (7) days after receipt of Notice to Proceed and to begin its submittal process. The Project Schedule is an integral part of this contract. Certain construction sequences and priorities must take place in order to meet the target dates. Concentrated work periods will occur and each Contractor is responsible to staff the project as required by the current Construction Schedule or as directed by the Construction Manager. Contractor will cooperate with the Construction Manager in planning and meeting the required sequences of work and Project Schedule as periodically updated by the Construction Manager.

6.8 All bids must include insurance limits in accordance with Article 11 of the Section 007300 SUPPLEMENTARY CONDITIONS.

6.9 Hoisting, scaffolding and material handling is the responsibility of each Contractor, unless otherwise noted.

6.10 Contractor will be responsible for layout of its own work. The Construction Manager will provide benchmark and layout of the building line.

6.11 Each contractor will be responsible to keep clean public roadways soiled by construction traffic on a daily basis. If cleaning is not done, the Construction Manager may perform the cleaning on an overtime basis and back charge the Contractor responsible.

6.12 Contractor Scopes of Work and Schedule are interrelated. Familiarity with each is required.

6.13 The Construction Manager will provide testing services for soil, concrete, masonry and steel. Other testing as required by the Contract Documents will be in accordance with the technical specifications and/or the individual scope of work. Refer to Specification Section 004500 - QUALITY CONTROL.

6.14 Safety is the responsibility of each individual Contractor. The project will be governed under the guidelines of OSHA.

6.15 Inter-Contractor shop drawing distribution will be performed by the Construction Manager through Building Blok (EDIS web based accounting system). Contractor is individually responsible for either coordinating his work with these distributed drawings or notifying the Construction Manager, in writing, of any discrepancies.

6.16 Coordination with other trades will be required. The Contractor will be required to attend periodic coordination and preinstallation meetings with other trades where requirements, conflicts and coordination issues will be discussed and resolved. Attendance when requested will be mandatory. If inter-Contractor coordination is not satisfactorily performed, the conflicting Contractors shall mutually share the cost to relocate and/or reinstall their work.

6.17 Contractor shall submit a schedule of values to the Construction Manager prior to the submission of their first invoice for approval on AIA G702/CMa, Application for Payment and G703, Continuation Sheet. This will be formally submitted on EDiS web based Accounting System, (Building Blok)

6.18 Contractor is expected to review and coordinate its Work with the complete set of Contract Documents, including all items noted as by his trade whether or not shown on that particular set of drawings. Documents are available at the site for review and all contract drawings will be available on EDiS web based Accounting System, (Building Blok).

6.19 Contractor is responsible for obtaining all necessary permits required for his work, including street permits. Unless otherwise noted, building permit shall be secured by the Construction Manager. Any subcontractor who will be restricting access to street, right of way or adjacent property must notify the Construction Manager 48 hours in advance. All MEP permits will be by the responsible MEP contractor awarded the contract.

6.20 Contractor's License: Submit a copy of all business licenses required by local and state agencies.

6.21 Contractor shall absorb, without additional compensation, any and all costs of working beyond normal hours to maintain job progress in accordance with the current construction schedule. No additional charges will be accepted for necessary coordination in order to maintain current construction schedule.

6.22 No asbestos or PCB's in or on any material or equipment will be accepted or allowed on this project. All hazardous materials will be treated in accordance with all State and Federal regulations.

6.23 Provide dailyfine clean up of the work is the responsibility of each individual Contractor which includes broom cleaning of their debris as required. Contractor will be individually back charged by the Construction Manager for clean up not satisfactorily performed by the Contractor.Daily Fine clean up on a daily basis shall be defined as those means/methods utilized to perform the daily cleaning tasks without producing dust, noise and stacking of stored materials. All debris must be removed from the building at the end of each work day.

6.24 In the event asbestos is uncovered, the Contractor shall notify the Construction Manager of the areas requiring removal of asbestos. The Construction Manager shall then coordinate the removal with the Owner.

6.25 Existing mechanical, electrical, plumbing, sprinkler, medical gas, fire alarm, etc. systems will be shut off and locked out by the Owner as required by the Work. Tie-in's and modifications to those systems will be performed by the specific Contractor associated

with the work as indicated in the Contract Documents. Re-energizing and re-start up of all systems should be performed by the Owner.

6.26 Normal work hours for this project are from 7:00 a.m. to 3:30 p.m. Any work to be performed outside of these hours must receive prior approval from the Construction Manager. Requests to work beyond normal work hours shall be submitted at least 48 hours prior.

6.27 The Safety Cable System shall not be altered or removed without a written request submitted to the Project Manager with a copy to the Field Manager. It shall be the responsibility of each and every Contractor that is removing or altering the Safety Cable System to maintain the fall protection safety provided by the safety cable and not leave the area unprotected. Each and every Contractor shall be responsible to re-install the Safety Cable System immediately after work is completed. Each and every Contractor shall be responsible to re-install the Safety Cable System in accordance to OSHA standards.

6.28 In the event the Contractor has non-English speaking employees or subcontractors on the project, they shall have a superintendent or foreman on site, at all times, who speaks English and can communicate with Contractor's employees. Should the Contractor fail to meet this requirement, at any time, Construction Manager may direct all Work to stop until the proper supervision is on site. The Contractor will be responsible for maintaining the project work schedule and make up at its own expense, any delay to the Schedule resulting from the work stoppage.

6.29 Contractor is responsible for having a competent project superintendent/foreman on-site during all work performed under its contract.

6.30 Contractor shall provide the necessary safety barricades and railings required to complete their work and comply with all OSHA, local code and contract specifications.

6.31 Punch List Procedures: Contractor shall be given a copy of the punch list with his appropriate work identified. Contractor shall have nine (9) calendar work days to complete its punch list work. On the 10th day or as determined by the Construction Manager, the Construction Manager shall employ other contractors, as required, to complete any incomplete punch list work and retain from the appropriate Contractors retainage all costs incurred.

6.32 Each contractor shall include all costs associated with additional shifts or extended hours of labor, equipment or materials in order to place and complete integral installations such as concrete, shoring, MEP components, etc.. It shall be assumed that no additional labor costs will be accepted for these costs that may extend the working day..

6.33 All contractors are to review and refer to Bid Pac "B" drawings in preparation for the submission of bids for this package, Bid Pac "C"

"FOR REFERENCE ONLY"

CONTRACT NO. B-01 - SITEWORK

A. Work included in this contract consists of, but is not necessarily limited to, all labor, materials and equipment for:

- Technical Specification sections:

Division 0	Bidding and Contract Requirements
Division 1	General Requirements
Section 012500	Substitution Procedures
Section 013300	Submittal Procedures
Section 015639	Temporary Tree and Plant Protection
Section 017700	Closeout Procedures
Section 017900	Demonstration & Training
Section 017419	Construction Waste Management and Disposal
Section 018113	Sustainable Design Requirements
Section 019113	General Commissioning Requirements
Section 024119	Selective Demolition
Section 311000	Site Clearing
Section 312000	Earth Moving
Section 312319	Dewatering
Section 313116	Termite Control
Section 315000	Excavation Support and Protection
Section 321216	Asphalt Paving
Section 321313	Concrete Paving
Section 321373	Concrete Paving Joint Sealants
Section 329200	Turf & Grasses
Section 329300	Plants
Section 329600	Transplanting
Division 21, 22, 23	Fire Protection, Plumbing, HVAC
Division 26 & 28	Electrical

This contract also includes, but is not necessarily limited to, all labor, materials and equipment for the following:

- Provide sitework, site demolition, storm, sanitary and water utilities, paving, striping, signage (Including bases), curbs, walks, landscaping, and topsoil/seeding.

- Provide demolition and removal of all structures outside of the building footprint as indicated on the Contract Documents. All building demolition shall be performed by the demolition or MEP contractor.

- A site visit and site examination shall be mandatory in the preparation of this bid.

- Furnish, install, maintain and remove sediment control system including sediment control plan. Maintain sediment control until substantial completion established by DNREC.

- Provide clearing, grubbing and removal and relocation of trees, roots and stumps.

- Provide topsoil stripping and temporary stockpile area on site.

- Contractors should carefully review the soil borings as they relate to the extent of rubble to be removed and other man made obstructions.

- Provide daily fine clean up of the work is the responsibility of each individual Contractor which includes street cleaning of their debris as required. Daily street clean up on a daily basis shall be defined as those means/methods utilized to perform the daily cleaning tasks without producing mud or dirt in roadways adjacent to site. All debris must be removed from all streets outside the limit of disturbance (as indicated on the Civil Drawings) at the end of each work day, as long as Sitework is being completed by this contractor.

- Provide saw cutting and removal of sidewalks, curbs, etc. in the performance of work is this Contractor's responsibility. Rock excavation (if applicable) will be paid for on a unit price basis.

- Provide rough grading for area defined on site drawings for building, lawn areas, bituminous roads, parking and walkways. Preparation of subgrade for building slabs, walks and pavements.

- Concrete Contractor will be responsible for laying out all concrete work as shown on the structural and architectural drawings. (Within the footprint of the building and additions) The Sitework contractor will be responsible for all site concrete and excavation outside of the building footprint and proposed additions. This work shall be coordinated with this Contractor who will be performing the sitework. The Concrete Contractor and this Contractor are to coordinate this procedure so that there are no additional costs to the Owner for additional excavation or concrete.

- Provide all plant material and all associated work including, but not limited to, staking, watering, weeding, etc.

- Provide planting soil mix in beds and topsoil. Provide all additional soil mix required to set plant materials and final grading.

- Provide filter fabric and mulch.

- Relocate water and sewer lines, including excavation and backfill, as required by the Contract Documents. Include all costs associated with coordination with local juristictions.

- Provide all storm and water piping.
- Include all demolition, excavation, backfill, capping and other miscellaneous items associated with this work.
- Backfilling is the responsibility of this Contractor. Soil types shall be in accordance with project documents.
- Sewer, water and fire lines to terminate +/- 5 feet from building line.
- Provide temporary barricades.
- Provide Bike racks and concrete pads as specified.
- Provide all concrete buttresses as indicated on site utilities when outside of the building footprint from +/- 5 feet from building line and out to the designated termination point.
- Provide hydrant and specified piping.
- A copy of the soils report is included within the project manual.
- Provide all dewatering of excavations until final acceptance.
- Provide placement and maintenance of sediment control systems including following specified sequences.
- Provide all labor, equipment and materials in order to complete SWM Pond.
- Provide as-built drawings for all SWM work and all Sitework installations.
- Furnish, install and maintain select fill under slab. This contractor shall provide subgrade for proposed building addition. All excavations for foundations, stone, concrete & rebar for building foundations and slab are to be provided by the concrete contractor.
- Provide a certified construction reviewer (CCR) to perform inspections and provide written reports; signed and sealed by a professional engineer. These inspections shall be provided on a weekly or bi-weekly basis (As specified by DNREC) throughout the length of the project.
- Provide all DelDOT permits related to work for this project.
- Furnish, install and remove temporary orange construction fencing, silt fencing and chain linked fencing as indicated on Civil Drawings. Provide at least (2) two 16'-0" gates to be located by the Construction Manager.
- Remove, Maintain, relocate utilities including, but not limited to the removal of light

standards. (Lighting and wiring will be provided by the Electrical Contractor.

- Furnish, install, maintain and remove temporary walks as shown on the site plan.

- Proof rolling of limit of excavation.

- All utilities shall be brought to within +/- 5 feet of the building line by this Contractor. The connection and all utilities from +/- 5 feet and into the building shall be by others.

- Backfilling as detailed below is the responsibility of this Contractor. Soil types shall be in accordance with Del Dot standard specifications.

  It is the intent to use on site material and not imported fill. The use of this onsite material shall conform with the compaction requirements as specified on Civil drawings and in Specification Section 312000. If the onsite material does not meet those requirements or if there is insufficient on site material available, this contractor shall import at no additional expense to the project sufficient material to complete the work.

- Provide pipe and backfill for foundation drainage.

- Provide and maintain stabilized site entrance.

- Provide street cleaning of mud, etc. on a daily basis. This contractor shall include the costs of a street sweeper to sweep the site for a period of 1 hour for 50 days. The Construction Manager will notify the contractor when the sweeping will be required.

- Provide all costs for temporary barricades, arrows, pedestrian protection, flagmen, etc. required to complete the work.

- This contractor will be responsible for removing all concrete pads that are outside of the building footprint. All MEP equipment, power and control wiring and piping on these pads will be removed by the responsible MEP trade.

- Base bid shall include all standard dewatering measures; utilizing trenches, crocks, stone and portable pumping measures. This contractor to provide these measures as required to perform their work. Well pointing and other similar means, if necessary, will be handled as a negotiated cost by the Owner.

- This Contractor shall, in cooperation with utility companies, remove or cause to be removed all light and power poles if required to be removed, at such time as the services utilizing said poles are no longer required.

- Utility equipment belonging to the utility companies, if to be retained by these companies, will be removed from the site by the company owning the equipment upon notification by this Contractor.

- This Contractor shall provide and maintain all temporary stabilized entrance as indicated on the Contract Documents, until completion of project.

- This Contractor shall include in the Contract Price and unit prices, the cost of all police traffic details required for the execution of the Work.

- Temporary water will be the responsibility of the individual Contractors. The Construction Manager will not provide this service.

- This contractor shall include a $10,000 allowance in their base bid for additional stone as required by the Construction Manager. This work can only be completed at the direction of the Construction Manager.

- This contractor shall include an allowance of $5,000 in their base bid for additional curb/sidewalk repairs. This work can only be completed at the direction of the Construction Manager.

- This contractor shall provide alternate pricing as requested on the bid form.

"FOR REFERENCE ONLY"

CONTRACT NO. B-02 - SELECTIVE INTERIOR DEMOLITION

A. Work included in this contract consists of, but is not necessarily limited to, all labor, materials and equipment for:

- Technical Specification sections

Division 0	Bidding and Contract Requirements
Division 1	General Requirements
Section 012500	Substitution Procedures
Section 013300	Submittal Procedures
Section 017700	Closeout Procedures
Section 017419	Construction Waste Management and Disposal
Section 017900	Demonstration & Training
Section 018113	Sustainable Design Requirements
Section 019113	General Commissioning Requirements
Section 024119	Selective Demolition

This contract also includes, but is not necessarily limited to, all labor, materials and equipment for the following:

- Provide all labor, material, trucking, dumpsters, equipment, hoisting, scaffolding, power, temporary facilities, permit fees, supervision, layout, clean up, etc. for the complete performance of all demolition work.

- This Contractor shall include all demolition and wrecking of the existing structures at the following location: 100 Campus Drive
  Dover, DE 19904-1383

- Provide demolition of all structures and their appertains construction to new subgrade level. Fill in all depressions to new subgrade grade level including vaults and areaways beyond the face of the building. Fill shall consist of clean non-combustible material such as brick and other masonry debris in compliance with the City building code. Excess material to be removed from site in a legal manner. Fill must be clean common compactable fill or select material.

- Remove from site all combustible material including, but not limited to wood, steel, iron, structural steel, and dispose of in a legal manner. No on site burning of material will be allowed at any time.

- Provide daily fine clean up of the work is the responsibility of each individual Contractor which includes broom cleaning of their debris as required. Daily Fine clean up on a daily basis shall be defined as those means/methods utilized to perform the daily cleaning tasks

without producing dust, noise and stacking of stored materials. All debris must be removed from the building at the end of each work day.

- Remove all debris from within the building footprint to dumpsters on a daily basis and dispose of debris in a legal manner.

- Items of demolition shall include, but not necessarily be limited to, complete structures, floor slabs, wall framing, masonry walls, structural steel, interior partitions and roofing. Mechanical and electrical equipment and fixtures, and related equipment shall be demoed by the responsible MEP trade.

- This Contractor shall notify the Construction Manager immediately if hazardous materials (i.e. asbestos, lead, PCB's, etc.) are uncovered. At that time, all work in the affected area will be stopped until proper removal can be completed by others (i.e. hazardous material abatement contractor).

- Temporary maintenance standby labor such as for temporary water, temporary power, temporary light and the like where required due to this Contractor's work is to be included within the Contract Price.

- This Contractor shall exercise all due precautions to minimize construction hazards which in any way would cause discomfort or danger to the existing building.

- This Contractor shall collect and remove from the site daily all rubbish, scrap and other debris resulting from its operations.

- All light, power, water and any other utilities, including special provisions for hookups to same for this Contractor's operations will be provided by this Contractor within the Contract Price.

- This Contractor shall comply with all Federal, State and local laws requiring noise control and hours which work is to be conducted. Mufflers, "whisperized" compressors, etc., shall be used for compliance with laws and ordinances throughout the course of the Work.

- It is understood that all Work under this Contract shall be in strict accordance with the Building Code with the City, State and any other agency having jurisdiction. In the event of any conflict in any provisions of any regulatory agency and Contract Documents, the more stringent requirements shall apply.

- This Contractor is aware of the structural capacities of various portions of the structure. Cranes, materials, deliveries and material storage, shall not exceed rated capacities without this Contractor taking appropriate steps to compensate for the imposition of loads which may exceed the design criteria and which are imposed solely by this Contractor's operations.

- This Contractor shall provide any and all "fire watch" personnel required due to the Contractor's cutting, burning, welding or other open flame activity. No additional costs will be accepted for fire watch. Please include all necessary costs for this in base bid.
- This Contractor shall submit proposed methods and operations of building demolition to the Owner, his representative or agents for review prior to the start of work, including a schedule of coordinating the shut off, capping and/or continuation of utility services as required.

- This Contractor shall visit the site of the proposed work, fully acquaint and familiarize himself with the conditions as they exist and the character of the operations to be carried out under the proposed Contract, and make such investigation as he may see fit so that he shall fully understand the facilities, physical conditions and restrictions affecting the work under the Contract. Claims for additional compensation and/or extensions of time because of Contractor's failure to familiarize himself with all conditions which might affect the work shall not be allowed.

- Before proceeding with the demolition work, this Contractor shall obtain a permit from the City, protect all public sidewalks, streets or thoroughfares and all property adjacent to the site as required by such codes, ordinances, rules and regulations, including, but not limited to, scaffolding, sidewalk bridges, barricades, aprons, warning signs and lights.

- This Contractor, before commencement of any part of the Work, shall give any notices, required to be given to an adjoining landowner and other parties.

- This Contractor, in the performance of the Work under his subcontractor, shall maintain all required means of egress from the existing buildings and alter such stairs, platforms and fire escapes as required to satisfy all agencies having jurisdiction.

- Before demolition work is started, existing sewer, water, gas and other service lines to the existing buildings shall be shut off, disconnected and capped or plugged in accordance with the requirements of the utility companies or other authorities having jurisdiction. This Contractor shall notify all such authorities in advance and obtain their approval and cooperation in shutting off utilities. All costs in connection with disconnecting utilities shall be borne by this Contractor.

- This Contractor shall take special precautions to shore, brace, support any elements needed to perform the demolition identified on the contract documents.

- Provide, maintain and remove temporary weather protection between demolition and reinstallation of permanent systems.

- Provide labor, materials & equipment to relocate all items that are identified for reinstallation. These items shall be protected and transported off site. Upon notification of materials, these items are to be provided back to the site at no additional costs to the project.

- Provide the removal of the existing entrance canopy. This entrance shall be temporarily closed in from weather and have plywood enclosure built temporarily to provide security. Once permanent items are supplied, this contractor shall remove the temporary protection.

- Provide saw cutting, excavation, removal and disposal of existing concrete for recessed rails for compact shelving. This contractor shall coordinate the location with the Concrete Contractor. The Concrete Contractor will perform the concrete and setting of rails only.

- Existing services to remain will be defined by the Owner prior to or immediately after the start of demolition work.

- This Contractor shall make a careful examination of the structures to be demolished and the adjoining property and utilities which are to remain; take whatever precautions are necessary and carry on operations so as to prevent personal injury and any settlement, collapse, damage from falling debris or other causes to adjacent building.

- Any damage to public property, private property, or to utilities due to demolition operations, or the Contractor's neglect, shall be corrected by this Contractor, in a manner approved by the Owner and the parties whose property has been damaged, all at no additional cost to the Owner.

- Miscellaneous equipment and furnishings belonging to the Owner, if to be retained by the Owner, will be removed before the commencement of the demolition work. All other equipment or furnishings attached, remaining, in the building at the start of the demolition work shall become the property of this Contractor and shall be removed and disposed of by this Contractor.

- All equipment, materials and debris shall be regularly removed by this Contractor from the Site as work progresses in such manner as not to create a nuisance, and shall be disposed of by this Contractor at his own expense, at locations to be determined by this Contractor. Permits required in connection with the disposal of the materials shall be obtained by this Contractor. Disposal shall be in accordance with all Federal, State and local laws, rules, codes, orders and regulations.

- Provide demolition of slabs as indicated for file storage system and large areas in and adjacent to mechanical work. MEP trades will be responsible for shoring, dewatering and installation of specified systems, and backfill to top of subgrade. The Concrete Contractor shall provide new slab on grade after backfilling has been inspected.

- Materials and equipment to be salvaged or which have been sold to others by this Contractor must be promptly removed by this Contractor, and shall not be stored at the site. The offering, advertising, display or sale of materials and equipment will not be permitted. The owner is entitled to all salvaged materials.

- Contractor shall remove debris promptly and will not burn anything on the site. Contractor shall keep required fire extinguishing equipment in serviceable condition, properly distributed so that it will be available for immediate use, particularly during any acetylene cutting operations. This Contractor shall afford adequate facilities for inspection by, and carry out the recommendations of, the local Fire Department. This Contractor shall maintain one fire riser during demolition.

- This Contractor shall, prior to the start of Work, provide the name and location of proposed dump site to receive the demolition debris. Dump site must be licensed and acceptable to all local government agencies having jurisdiction.

- This Contractor shall provide signed and stamped dump site debris tickets identifying the location, date, time and quantity of debris deposited at the dump site.

- This contractor shall provide alternate pricing as requested on the bid form.

- This Contractor shall include in the base bid 100 hours of common labor time for work to be directed by the Construction Manager for unforeseen work

- This contractor shall provide alternate pricing as requested on the bid form.

"FOR REFERENCE ONLY"

CONTRACT NO. B-03 - CONCRETE

A. Work included in this contract consists of, but is not necessarily limited to, all labor, materials and equipment for:

- Technical Specification sections:

Division 0	Bidding and Contract Requirements
Division 1	General Requirements
Section 012500	Substitution Procedures
Section 013300	Submittal Procedures
Section 017700	Closeout Procedures
Section 017419	Construction Waste Management and Disposal
Section 017900	Demonstration and Training
Section 018113	Sustainable Design Requirements
Section 019113	General Commissioning Requirements
Section 033000	Cast-In-Place-Concrete
Section 071113	Bituminous Dampproofing
Section 072100	Thermal Insulation
Section 079200	Joint Sealers
Section 312319	Dewatering
Section 315000	Excavation Support and Protection
Section 321373	Concrete Paving Joint Sealants

This contract also includes, but is not necessarily limited to, all labor, materials and equipment for the following:

- Provide excavation and backfill for the work associated with concrete foundations, stair and slabs. This includes all foundations, footings, piers, grade beams, slabs on grade, and all reinforcing steel. All concrete work shall be within the footprint of the building, including the new addition and entrance vestibule. All Sitework (Work outside of footprint of building shall be completed by the Sitework contractor.)

- This Contractor to excavate down to the bottom of all wall and column footings as shown on drawings. This Contractor is responsible for the layout of bulk excavation. This Contractor to extend the bulk excavation outside building plan in order to facilitate foundation construction and maintain safety requirements.

- Provide perimeter protection of all excavated areas until suitably backfilled.

- This Contractor will be responsible for laying out all concrete work as shown on the structural and architectural drawings.

- This Contractor to furnish and install reinforcing steel, formwork, admixtures, curing compound, vapor retarders, sealers as required in the Contract Documents. Sealers should be applied to all exposed concrete surfaces.

- Provide protection of liquid floor treatments as indicated.

- Provide perimeter and below slab insulation at foundations and foundation walls.

- Provide underslab vapor barrier, insulation, reglets, water stops, control and construction joints (including required caulking at control and construction joints).

- Placement of related items furnished under other specification sections is the responsibility of this contractor.

- Provide daily fine clean up of the work is the responsibility of each individual Contractor which includes broom cleaning of their debris as required. Daily Fine clean up on a daily basis shall be defined as those means/methods utilized to perform the daily cleaning tasks without producing dust, noise and stacking of stored materials. All debris must be removed from the building at the end of each work day.

- Anchor bolts and leveling plates to be installed by this Contractor and furnished by the Structural Steel contractor. Installation within required tolerances. Anchor bolt assemblies to be placed with templates only. Contractor shall supply as-built drawings to steel erector for coordination prior to steel placement.

- All blockouts and embedment's required by plans and specifications.

- This Contractor shall furnish and install all sleeves for incoming utilities at the perimeter walls.

- This Contractor is responsible for grouting all structural steel base or leveling plates and elevator sill angles.

- The saw cutting, excavation, removal and disposal of existing concrete for recessed rails for compact shelving will be performed by the Demolition Contractor. This contractor shall coordinate the location with the Demolition Contractor. The Concrete Contractor shall provide the concrete, rebar, forming, etc. and provide the installation of the rails only.

- Weather and frost protection requirements for cold weather concrete are not anticipated for this project due to the time duration of the project. Do not include any costs for this work in base bid.

- Coordinate the "Notch" in the concrete slabs to allow for a future Contractor to easily install expansion joint details.

- Provide dewatering after acceptance from Sitework Contractor until re-acceptance by the Sitework Contractor.

- This Contractor will be responsible for laying out all concrete work as shown on the structural and architectural drawings. It will be the responsibility of the Sitework Contractor to maintain all open excavations and dewater as specified until the building subgrade is turned over to this Concrete Contractor. Once this Contractor has accepted this work it will be the responsibility of this Contractor to maintain and dewater all excavations until the concrete work is complete at which time dewatering will be the responsibility of the Sitework Contractor until final acceptance. This Contractor and the Sitework Contractor are to coordinate this procedure so that there are no additional costs to the Owner for additional excavation or concrete.

- Provide and maintain perimeter fall protection at excavated area per OSHA standards.

- Provide certified anchor bolt verification drawings to the Construction Manager for review prior to steel erection.

- Equipment bases and foundations shall be the responsibility of the Contractor providing the equipment.

- Asphalt concrete paving and portland cement concrete paving, sidewalks and curbs shall be provided by the Sitework Contractor.

- All concrete testing will be completed by the Construction Manager, however, it will be the responsibility of this Contractor to furnish all samples.

- Provide offsite disposal of all unsuitable excavated materials.

- Construction Manager will perform testing to ensure that FF/FL compliance is verified by an independent testing agency within 48 hours of completion of pour, per ACI (Section 8.15.4). Contractor must make any corrective action required after receipt of report.

- The Demolition Contractor will provide demolition of slabs as indicated for file storage system and large areas in and adjacent to mechanical work. The Mechanical Contractor must coordinate with other MEP trades, but is responsible for shoring, dewatering and installation of specified systems, and backfill to top of subgrade. The Concrete Contractor shall provide new slab on grade after backfilling has been inspected. The Mechanical Contractor shall provide demolition and to return SOG to correct grades work at the Bathroom slabs.

- Provide sloping for floor drains as detailed (Drains furnished by Mechanical Contractor.)

- This Contractor shall include the finishing of concrete slabs around floor penetrations

throughout the slab areas. These penetrations will consist of electrical boxes, stubbed conduits, mechanical piping and electrical and technology conduit stubs, etc.

- This Contractor shall provide means to allow for testing of concrete slabs to verify that they have been installed within the tolerance required by the contract documents. Testing and analysis of the slabs are to be coordinated and paid for by the Construction Manager.

- This Contractor shall include a minimum of three additional out of sequence remobilizations for concrete slab installation.

- This contractor shall provide alternate pricing as requested on the bid form.

"FOR REFERENCE ONLY"

CONTRACT NO. B-04 - MASONRY

A. Work included in this contract consists of, but is not necessarily limited to, all labor, materials and equipment for:

- Technical Specification sections:

Division 0	Bidding and Contract Requirements
Division 1	General Requirements
Section 012500	Substitution Procedures
Section 013300	Submittal Procedures
Section 017700	Closeout Procedures
Section 017419	Construction Waste Management and Disposal
Section 017900	Demonstration and Training
Section 018113	Sustainable Design Requirements
Section 019113	General Commissioning Requirements
Section 042000	Unit Masonry
Section 072100	Thermal Insulation
Section 076200	Sheet Metal Flashing and Trim
Section 079200	Joint Sealers
Section 312319	Dewatering
Section 315000	Excavation Support and Protection

This contract also includes, but is not necessarily limited to, all labor, materials and equipment for the following:

- Provide labor, materials and equipment to provide masonry units, grouting of cells, reinforcing, accessories and related work.
- Provide caulking of masonry to masonry and to dissimilar materials.
- Provide integral masonry flashings, expansion joints, insulation and other related items as required.
- Provide mock up as required.
- Grouting of door frames at masonry openings as required.
- Provide weather protection as required to perform the work and maintain the project schedule.
- Provide scaffolding as required to complete the work.

- Dewatering of work areas.
- Provide layout of the work including responsibility for all elevations and dimensions as they affect other Contractor's work.
- Provide lintels required by this Contract or install loose lintels furnished by others.
- Provide fill at hollow concrete masonry units.
- Provide setting of reinforcing steel in block walls.
- Provide silicone waterproofing.
- Provide daily fine clean up of the work is the responsibility of each individual Contractor which includes broom cleaning of their debris as required. Daily Fine clean up on a daily basis shall be defined as those means/methods utilized to perform the daily cleaning tasks without producing dust, noise and stacking of stored materials. All debris must be removed from the building at the end of each work day.
- Provide temporary protection for final wash down/cleaning of masonry.
- Flashing Summary

  Thru wall and cavity flashing below the roof line shall be by the Masonry Contractor.
  Thru wall and cavity flashing above the roof line shall be by the Roofing Contractor.
- Provide cutting, fitting and building into masonry work, embedments provided by others.
- Provide all firesafing and fire caulking as required. Work related to masonry work.
- Furnish masonry veneer anchors to Exterior Structural Stud Contractor for installation.
- Bond beams including reinforcing and fill.
- Furnish and install all masonry veneer anchors where required.
- This contractor shall be responsible for disposal of masonry debris in to Construction Manager provided dumpster. This is a recycling job site. Correct contents must be distributed in to proper dumpsters.
- This Contractor shall include a $5,000 allowance for the additional masonry repairs not shown. All other items remain the responsibility of the Masonry Contractor. The allowance will be allocated by the Construction Manager on a time and material basis. All remaining allowance shall be returned to the Owner at completion.

- This contractor shall provide alternate pricing as requested on the bid form.

"FOR REFERENCE ONLY"

CONTRACT NO. B-05 - STRUCTURAL STEEL & MISCELLANEOUS METALS

A. Work included in this contract consists of, but is not necessarily limited to, all labor, materials and equipment for:

- Technical Specification sections:

Division 0	Bidding and Contract Requirements
Division 1	General Requirements
Section 012500	Substitution Procedures
Section 013300	Submittal Procedures
Section 017700	Closeout Procedures
Section 017419	Construction Waste Management and Disposal
Section 017900	Demonstration and Training
Section 018113	Sustainable Design Requirements
Section 019113	General Commissioning Requirements
Section 051200	Structural Steel Framing
Section 053100	Steel Decking
Section 055000	Metal Fabrications

This contract also includes, but is not necessarily limited to, all labor, materials and equipment for the following:

- Provide structural steel, miscellaneous structural components, and roof decking.

- Furnish anchor bolts and leveling plates to the Concrete Contractor for placement in concrete piers.

- Field check all anchor bolts prior to beginning erection.

- Framing out for openings (roof drains, mechanical openings, access hatches, etc.). Assume opening frames will be field installed.

- Prime paint systems, galvanizing, and related finishing of steel items, including touch up. Coordinate the beams that are to be fireproofed and treat as specified.

- Masonry or precast anchors welded to steel columns and beams.

- Furnish, install, maintain and remove perimeter safety steel cables to conform with all OHSA standards for all trades.

- The Steel Contractor will own all connections to masonry whether they are field welds or shop welds. Conditions that require in field welding and assembly are the responsibility

of this Contractor. Field coordination with the masonry installer will be this Contractor's responsibility.

- All steel testing will be the responsibility of the Construction Manager, however, this Contractor will cooperate with the testing agency in the inspection at the fabrication shop and in the field.

- Provide layout, for all steel conditions and where they abut other trades..

- Provide daily fine clean up of the work is the responsibility of each individual Contractor which includes broom cleaning of their debris as required. Daily Fine clean up on a daily basis shall be defined as those means/methods utilized to perform the daily cleaning tasks without producing dust, noise and stacking of stored materials. All debris must be removed from the building at the end of each work day.

- No electrical power for welders will be provided.

- Provide data and submittal information related to the Scope of this Contract signed and sealed by a Professional Engineer as required by the Contract Documents.

- This Contractor shall fabricate, weld and install all reinforcing anchors that connect the structural steel to the masonry systems. Provide all shop fabrication, a field installation and field welding regardless of the weld symbols.

- This Contractor shall include all necessary staging, rigging, matting and remobilizations to accommodate this erection sequence.

- Furnish loose steel lintels, angles, plates and embedded items to the Concrete and Masonry contractors.

- Provide miscellaneous rough hardware, iron shapes, framing and support angles.

- Provide galvanizing, as required.

- Provide all anchoring devices, fasteners, inserts and other related items associated with the installation of the above items.

- Provide field touch-up paint.

- Verify field dimensions.

- This Contractor shall include a $5,000 allowance for the maintenance portion of the perimeter cables. All other items remain the responsibility of the Steel Contractor. The allowance will be allocated by the Construction Manager on a time and material basis. All remaining allowance shall be returned to the Owner at completion.

- This contractor shall provide alternate pricing as requested on the bid form.

"FOR REFERENCE ONLY"

CONTRACT NO. B-06 - CARPENTRY AND GENERAL WORK

A. Work included in this contract consists of, but is not necessarily limited to, all labor, materials and equipment for:

- Technical Specification sections:

Division 0	Bidding and Contract Requirements
Division 1	General Requirements
Section 012500	Substitution Procedures
Section 013300	Submittal Procedures
Section 017700	Closeout Procedures
Section 017419	Construction Waste Management and Disposal
Section 017900	Demonstration and Training
Section 018113	Sustainable Design Requirements
Section 019113	General Commissioning Requirements
Section 061053	Miscellaneous Rough Carpentry
Section 061600	Sheathing
Section 062023	Interior Finish Carpentry
Section 081113	Hollow Metal Doors and Frames
Section 081416	Flush Wood Doors
Section 087100	Door Hardware
Section 101400	Signage
Section 102113	Toilet Compartments
Section 102800	Toilet, Bath and Laundry Accessories
Section 104413	Fire Extinguisher Cabinets
Section 104416	Fire Extinguishers
Section 105626	Mobile Storage Shelving
Section 113100	Residential Appliances
Section 122116	Vertical Louver Blinds
Section 123200	Manufactured Wood Casework

This contract also includes, but is not necessarily limited to, all labor, materials and equipment for the following:

- Provide labor and materials to perform the work related to all carpentry and general work.

- Provide all rough carpentry related to the exterior skin of the building including wood nailers and blocking and exterior sheathing.

- Provide all rough carpentry related to the interior of the building including blocking, wood nailers, etc. for the installation of fire extinguishers, doors, windows, toilet

accessories, cabinets, toilet partitions, casework, millwork, etc. including fire treating, as required.

- Provide all field trimming required to adjust to existing conditions.
- Provide all finish hardware related to all doors (hollow metal and wood), including receipt of hardware at the curb side. (Aluminum doors will be provided by Glass & Glazing Contractor)
- Provide all hollow metal and wood doors. This includes all handling and relocating of existing doors to be relocated. This also includes the receipt of doors and frames at the curb side.
- Provide all factory finishes of doors and frames. The Painting Contractor shall provide painting and staining of doors and frames not factory finished.
- Provide all keying for Hollow Metal and Wood Doors. All lock sets. Provide Owner with copy of pin schedule.
- This contractor is responsible for all field measurements required to retrofit frames and/or doors in existing openings.
- Deliveries to correspond to the construction schedule.
- Provide field assistance to Electrical Contractors regarding door and hardware installations.
- Provide all millwork, casework and trim.
- Provide all shelving and coat/clothing rods.
- Provide all counters including solid surface as indicated.
- Projection screens.
- Provide exterior and interior signage. (Exterior lighting shall be provided by Electrical Contractor)
- Provide toilet partitions.
- Provide toilet and bath accessories.
- Provide fire extinguishers, cabinets and accessories.
- Provide window treatments.

- Recessed entrance mats and frames shall be provided by Flooring Contractor.
- Coordinate cutting holes in casework with other trades.
- Provide appliances. MEP installations such as power and plumbing will be provided by MEP contractors.
- Provide mirrors.
- Provide all anchoring devices, fasteners, inserts and other related items associated with the installation of the above items.
- This Subcontractor shall at a minimum provide and maintain for the length of the project, one temporary fire extinguisher for each 3,000 sq. ft of the protected building area. Fire extinguishers shall be 10lb, Multi-Purpose (ABC) dry chemical, UL labeled, with a rating of 3a:40bc.
- Provide daily fine clean up of the work is the responsibility of each individual Contractor which includes broom cleaning of their debris as required. Daily Fine clean up on a daily basis shall be defined as those means/methods utilized to perform the daily cleaning tasks without producing dust, noise and stacking of stored materials. All debris must be removed from the building at the end of each work day.
- Coordinate electrical requirements with any automatic door operations.
- All doors and hardware shall be provided by this contractor. All electrical wiring, consistent with TA drawings, shall be provided by Electrical Contractor.
- Provide labor and handling to provide offsite storage to remove, redeliver and reinstall doors that are to be reinstalled.
- All material to be stored by this Contractor until delivery is requested.
- Coordinate card reader requirements with electrical hardware.
- This Contractor shall include a $15,000 allowance in his contract to supply and install temporary weather protection. This work shall be utilized at the Construction Managers discretion.
- This Contractor shall include in the base bid 100 hours of Journeyman carpenter time and 100 hours of common labor time for work to be directed by the Construction Manager for safety and temporary barricades.
- This contractor shall provide alternate pricing as requested on the bid form.

"FOR REFERENCE ONLY"

CONTRACT NO. B-07 - ROOFING

A. Work included in this contract consists of, but is not necessarily limited to, all labor, materials and equipment for:

- Technical Specification sections:

Division 0	Bidding and Contract Requirements
Division 1	General Requirements
Section 012500	Substitution Procedures
Section 013300	Submittal Procedures
Section 017700	Closeout Procedures
Section 017419	Construction Waste Management and Disposal
Section 017900	Demonstration and Training
Section 018113	Sustainable Design Requirements
Section 019113	General Commissioning Requirements
Section 072100	Thermal Insulation
Section 074113	Metal Roof Panels
Section 075323	(EPDM) Ethylene-Propylene-Diene-Monomer Roofing
Section 076200	Sheet Metal Flashing & Trim
Section 083113	Access Doors & Frames

This contract also includes, but is not necessarily limited to, all labor, materials and equipment for the following:

- Provide EPDM roofing system, including rigid and tapered insulation and all related accessories.

- Provide Metal roofing system, including rigid and tapered insulation and all related accessories.

- Provide demolition of existing roof and accessory components and provide new system as indicated. It is the intention of this note that all roof or sub-roofing demolition shall be completed by this contractor other than structural steel or metal studs. All sheathing demolition shall be completed by this contractor.

- Provide temporary roofing system needed to maintain interior finishes after demolition is complete and before the new structure/decking is in place.

- Foundation dampproofing and waterproofing will be completed by the Concrete Contractor.

- Provide snow guards as recommended by manufacturer and as indicated on contract documents.

- Provide caulking related to roofing, flashing and roof accessories.
- Flashing of the downspouts shall be by this contractor.
- Provide gutters and downspouts that are to match existing.
- Provide guards in gutters and at all valleys
- Provide the lightning protection system.
- Provide access through attic separation as indicated
- Provide daily fine clean up of the work is the responsibility of each individual Contractor which includes broom cleaning of their debris as required. Daily Fine clean up on a daily basis shall be defined as those means/methods utilized to perform the daily cleaning tasks without producing dust, noise and stacking of stored materials. All debris must be removed from the building at the end of each work day.
- Perform cutting, patching and maintenance of temporary patch for work performed by others on existing roofs intended to be re-roofed as part of this work.
- Provide metal drip edges.
- Provide metal fascia.
- Provide vinyl soffit at entrance canopy.
- Provide gravel stops.
- Provide ridge vents.
- Provide hips and valleys and all flashing associated with these installations.
- Coordinate the penetrations with the MEP trades so that penetrations align with seams. No seams will be allowed to be penetrated for any MEP installations.
- Provide expansion joints that are integral to the roof.
- Provide permanent patching of existing roofing systems at areas of demolition. All patching shall conform to original warranty requirements and documents.
- Provide gutters, downspouts and splash pans.
- Provide metal scuppers and related work.

- Wood blocking shall be provided by Carpentry & General Works Contractor.

- Provide all flashing and sheet metal.

- Provide capping details at existing exhaust fans as shown. The Mechanical Contractor shall be responsible for modifying duct and exhaust fans as indicated.

- Flashing Summary:

  Thru wall and cavity flashing below the roof line shall be by the Masonry Contractor.
  Thru wall and cavity flashing above the roof line shall be by the Roofing Contractor.

- This contractor shall provide alternate pricing as requested on the bid form.

"FOR REFERENCE ONLY"

CONTRACT NO. B-08 – GLASS & GLAZING/STOREFRONTS

A. Work included in this contract consists of, but is not necessarily limited to, all labor, materials and equipment for:

- Technical Specification sections

Division 0	Bidding and Contract Requirements
Division 1	General Requirements
Section 012500	Substitution Procedures
Section 013300	Submittal Procedures
Section 017700	Closeout Procedures
Section 017419	Construction Waste Management and Disposal
Section 017900	Demonstration and Training
Section 018113	Sustainable Design Requirements
Section 019113	General Commissioning Requirements
Section 079200	Joint Sealers
Section 083113	Access Doors and Frames
Section 084113	Aluminum-Framed Entrances and Storefront
Section 084126	All Glass Entrances and Storefronts
Section 085113	Aluminum Windows
Section 087100	Door Hardware
Section 088000	Glazing

This contract also includes, but is not necessarily limited to, all labor, materials and equipment for the following:

- Provide, storefront, glass and glazing systems, including interior vision panels.

- Provide aluminum door, and accessories. Include all pertinent systems and handling necessary for installation.

- Provide shimming, backerod and sealant at all window installations.

- Provide automatic aluminum door systems, including hardware.

- Provide all hardware for aluminum doors. All hollow metal and wood doors will be provided by the Carpentry & General Works contractor.

- All glass and glazing at exterior of building.

- Provide caulking related to storefront, interior and exterior glass systems as well as

aluminum door systems.

- Provide mock-ups as required by the Drawings and Specifications.
- Provide custom breakmetal trim and infill.
- Provide daily fine clean-up of the work is the responsibility of each individual Contractor which includes broom cleaning of their debris as required. Daily Fine clean up on a daily basis shall be defined as those means/methods utilized to perform the daily cleaning tasks without producing dust, noise and stacking of stored materials. All debris must be removed from the building at the end of each work day.
- Hoisting/scaffolding related to the work of this Contract.
- Coordinate edge of slab tolerances and field verify all rough openings.
- Provide caulking between the materials supplied under this section and the adjacent surfaces.
- Provide interior door, partition, vision panel and window glass.
- Coordinate glass types with partition and door fire ratings. Contact Construction Manager with any discrepancies.
- This contractor shall provide alternate pricing as requested on the bid form.

"FOR REFERENCE ONLY"

CONTRACT NO. B-09 - METAL STUD, DRYWALL, & EXTERIOR WALL PANELS

A. Work included in this contract consists of, but is not necessarily limited to, all labor, materials and equipment for:

- Technical Specification sections:

Division 0	Bidding and Contract Requirements
Division 1	General Requirements
Section 012500	Substitution Procedures
Section 013300	Submittal Procedures
Section 017700	Closeout Procedures
Section 017419	Construction Waste Management and Disposal
Section 017900	Demonstration and Training
Section 018113	Sustainable Design Requirements
Section 019113	General Commissioning Requirements
Section 054000	Cold-Formed Metal Framing
Section 054400	Cold-Formed Metal Trusses
Section 061600	Sheathing
Section 072100	Thermal Insulation
Section 072500	Weather Barriers
Section 074219	Metal Plate Wall Panels
Section 079200	Joint Sealers
Section 092216	Non-Structural Metal Framing
Section 092900	Gypsum Board
Section 09270	Gypsum Board Shaft Wall Systems

This contract also includes, but is not necessarily limited to, all labor, materials and equipment for the following:

- Provide metal studs, insulation, gypsum wallboard, taping, spackling,.
- Provide all metal stud framing required to back up masonry and metal wall panels.
- Provide batt insulation, both thermal and acoustical and related work.
- Provide structural stud assembly for the interior and exterior skin of the building.
- Acoustical sealant of penetrations in insulated drywall partitions.
- Access panel installation (assume 5 total).
- Include fire taping and sealing as indicated in the Contract Drawings.

- Provide expansion joint systems, including joint cover materials at concrete (slab on grade) and partitions.

- Provide expansion joints and cover systems related to all wall systems installed by this contractor. Ceiling and roofing expansion systems are by Acoustical Ceiling and Roofing Contractors.

- Provide scaffolding and lifts for this work.

- Provide labor and materials to ensure all general finish notes on drawing A602 are completed as directed.

- Comebacks and out-of-sequence work may be required and as such should be included.

- Provide daily fine clean up of the work is the responsibility of each individual Contractor which includes broom cleaning of their debris as required. Daily Fine clean up on a daily basis shall be defined as those means/methods utilized to perform the daily cleaning tasks without producing dust, noise and stacking of stored materials. All debris must be removed from the building at the end of each work day.

- Include all necessary field measurements.

- Include two (2) passes per floor to "touch-up" mechanical penetrations to insure ratings required. The first pass will be required prior to ceiling grid installation and the second pass will be required prior to final inspection for Certificate of Occupancy.

- Bidders are advised to pay particular attention to top of wall conditions, fire and smoke safing of slabs and acoustical sealants.

- Provide all metal framing as indicated for back up of other materials.

- Provide metal furring.

- Provide all glass fiber reinforced gypsum work including materials, taping (interior only).

- Provide engineered shop and installation drawings as specified.

- Provide stud construction related to framing out for openings in interior and exterior walls.

- Provide secondary support framing.

- Provide clips, anchors, supports and other accessories that interface between steel framing and steel studding.

- Provide wall sheathing and Tyvek exterior wall sheathings on structural steel studs.
- Comebacks and out-of-sequence work may be required and as such should be included.
- Provide fire resistant joint systems at all walls that are indicated.
- Provide panels at perimeter walls and penthouse and all necessary anchoring devices.
- Provide flashing of panels integral with the panel system.
- Provide caulking of exterior wall panels.
- Provide all miscellaneous metal items necessary to support panels other than required structural steel.
- Furnish anchorage items for embedding into other construction for support of panels.
- Galvanized, epoxy or stainless steel anchors as specified.
- Provide fascias and copings related to the all exterior panel system.
- This Contractor shall coordinate his shop drawings with the Window Contractor's shop drawings.
- Verification of field dimensions is the responsibility of this Contractor.
- This Contractor shall include a $10,000 allowance in his contract to provide additional touch up required for corrective work to drywall finishes.
- This Contractor shall include a $3,500 allowance in his contract to provide protection and additional insulation at separation wall between addition and existing building.
- This contractor shall provide alternate pricing as requested on the bid form.

"FOR REFERENCE ONLY"

CONTRACT NO. B-10 - ACOUSTICAL CEILINGS

A. Work included in this contract consists of, but is not necessarily limited to, all labor, materials and equipment for:

- Technical Specification sections

Division 0	Bidding and Contract Requirements
Division 1	General Requirements
Section 012500	Substitution Procedures
Section 013300	Submittal Procedures
Section 017700	Closeout Procedures
Section 017419	Construction Waste Management and Disposal
Section 017900	Demonstration and Training
Section 018113.13	Sustainable Design Requirements
Section 019113	General Commissioning Requirements
Section 079200	Joint Sealants
Section 095113	Acoustical Panel Ceilings

This contract also includes, but is not necessarily limited to, all labor, materials and equipment for the following:

- Provide acoustical panel ceilings, suspension system and hangers.
- Provide acoustical lay in insulation blankets above ceiling where.
- Provide supplemental suspension hangers at large ducts above ceilings and at openings for lighting fixtures.
- Continuous acoustical sealant on back of vertical leg before installing moldings.
- Furnish and install hold down clips where required by governing regulations for fire resistant ratings.
- Provide ceiling expansion joints. Frywall expansion joints are to be provided by others.
- Provide reflected ceiling layout, including field verification of existing conditions. Inform the Construction Manager if existing conditions differ from drawings and specifications.
- This Contractor shall provide openings in ceilings for sprinkler heads, lights, mechanical diffusers and grilles, etc. This will consist of cutting and touch up of paint as required.
- Attic stock.

- Provide daily fine clean up of the work is the responsibility of each individual Contractor which includes broom cleaning of their debris as required. Daily Fine clean up on a daily basis shall be defined as those means/methods utilized to perform the daily cleaning tasks without producing dust, noise and stacking of stored materials. All debris must be removed from the building at the end of each work day.

- Provide acoustical wall treatment.

- This Contractor shall include a $3,000 allowance in his contract to to be utilized by the Construction Manager.

- This contractor shall provide alternate pricing as requested on the bid form.

"FOR REFERENCE ONLY"

CONTRACT NO. B-11 - PAINT AND VWC

A. Work included in this contract consists of, but is not necessarily limited to, all labor, materials and equipment for:

- Technical Specification sections:

Division 0	Bidding and Contract Requirements
Division 1	General Requirements
Section 012500	Substitution Procedures
Section 013300	Submittal Procedures
Section 017700	Closeout Procedures
Section 017419	Construction Waste Management and Disposal
Section 017900	Demonstration and Training
Section 018113	Sustainable Design Requirements
Section 019113	General Commissioning Requirements
Section 079200	Joint Sealants
Section 099123	Interior Painting
Section 099300	Staining and Transparent Finishing

This contract also includes, but is not necessarily limited to, all labor, materials and equipment for the following:

- Provide all painting on all walls and ceilings indicated on the finish schedule.
- Provide sealing all interior joints between dissimilar materials that require sealants.
- Prime, paint, stain and caulk all wood trim and doors that is not already factory painted.
- Provide supplementary ventilation as required in enclosed spaces.
- Paint and caulk all hollow metal frames and doors as shown on the door schedule.
- Prefinished items will not be painted by this Contractor.
- Provide protection and maintenance of corridors after final painting. Protection will consist of poly protection from 6'-0" down to finished floor on all corridor walls. Include all costs for removal of protection in base bid.
- Provide minor patching prior to application of finishes.
- Provide painting of all exposed steel and lintels as indicated.

- Final coat of paint is to be installed after ceilings are installed, if directed by Construction Manager.

- Provide daily fine clean up of the work is the responsibility of each individual Contractor which includes broom cleaning of their debris as required. Daily Fine clean up on a daily basis shall be defined as those means/methods utilized to perform the daily cleaning tasks without producing dust, noise and stacking of stored materials. All debris must be removed from the building at the end of each work day.

- This Contractor to allow 160 man hours and all required paint materials for these man hours to be used as directed by the Construction Manager.

- Provide attic stock.

- This contractor shall provide alternate pricing as requested on the bid form.

"FOR REFERENCE ONLY"

CONTRACT NO. B-12 – FLOORING & CERAMIC TILE

A. Work included in this contract consists of, but is not necessarily limited to, all labor, materials and equipment for:

- Technical Specification sections:

Division 0	Bidding and Contract Requirements
Division 1	General Requirements
Section 012500	Substitution Procedures
Section 013300	Submittal Procedures
Section 017700	Closeout Procedures
Section 017419	Construction Waste Management and Disposal
Section 017900	Demonstration and Training
Section 018113.13	Sustainable Design Requirements
Section 019113	General Commissioning Requirements
Section 079200	Joint Sealants
Section 093000	Tiling
Section 096513	Resilient Base and Accessories
Section 096519	Resilient Tile Flooring
Section 096813	Tile Carpeting
Section 098616	Sheet Carpeting
Section 099300	Staining and Transparent Finishing
Section 124813	Entrance Floor Mats and Frames

This contract also includes, but is not necessarily limited to, all labor, materials and equipment for the following:

- Provide all flooring in accordance with the finish schedule and specifications.

- Provide all ceramic tile in accordance with the finish schedule and specifications.

- Prepare subfloor for finished flooring including leveling and patching. Base bid shall include all flashing patching and surface preparation required to perform the work of this Contractor.

- Provide resilient flooring.

- Provide all carpeting.

- Provide all resilient base.

- Provide resilient transition and reducer strips at edges of resilient flooring and at edges of

carpeting.

- Provide peel and stick poly floor protection in all corridors once finished materials have been installed. Include all costs associated with removal at completion of project..
- Provide VCT and products needed for installation of VCT.
- Provide attic stock.
- Provide entrance mat and frame.
- Provide cutting and fitting around work of others.
- Provide ceramic tile, marble tile and thresholds.
- Provide setting beds.
- Provide grout.
- Provide cutting and fitting around work installed by others.
- Provide patching and leveling.
- Provide protection ceramic tile until acceptance by Construction Manager. Protection shall be Masonite sheets taped down over entire floors. Include all costs for removal of protection at conclusion of project.
- Provide daily fine clean up of the work is the responsibility of each individual Contractor which includes broom cleaning of their debris as required. Daily Fine clean up on a daily basis shall be defined as those means/methods utilized to perform the daily cleaning tasks without producing dust, noise and stacking of stored materials. All debris must be removed from the building at the end of each work day.
- This Contractor shall include a $10,000 allowance in base bid for additional floor protection to be utilized by the Construction Manager. All floor flashing of new areas are to be included in base bid. This allowance is to be utilized at existing floor conditions only.
- This contractor shall provide alternate pricing as requested on the bid form.

CONTRACT NO. C-01 - FIRE PROTECTION

A. Work included in this contract consists of, but is not necessarily limited to, all labor, materials and equipment for:

- Technical Specification sections:

Division 0	Bidding and Contract Requirements
Division 1	General Requirements
Section 012500	Substitution Procedures
Section 013300	Submittal Procedures
Section 017700	Closeout Procedures
Section 017419	Construction Waste Management and Disposal
Section 017900	Demonstration and Training
Section 018113	Sustainable Design Requirements
Section 019113	General Commissioning Requirements
Section 210517	Sleeves and Sleeve Seals For Fire-Suppression Piping
Section 210518	Escutcheons For Fire-Suppression Piping
Section 210553	Identification For Fire-Suppression Piping and Equipment
Section 211100	Facility Fire-Suppression Water-Service Piping
Section 211313	Wet-Pipe Sprinkler System
Section 230000	General Requirements Mechanical & Electrical
Section 230529	Hangars and Supports for HVAC Piping and Equipment
Section 230553	Identification for HVAC Piping and Equipment
Section 283111	Digital, Addressable Fire Alarm System

This contract also includes, but is not necessarily limited to, all labor, materials and equipment for the following:

- Provide piping, fittings, couplings, valves, pipe restraints and sprinkler heads.

- Provide excavation and backfill related to fire protection work as detailed below is the responsibility of this Contractor. Soil types shall be in accordance with Del Dot standard specifications.

- Backfilling is the responsibility of this Contractor. Soil types shall be in accordance with project documents.

- Provide hoisting, rigging and scaffolding.

- Provide cadd version of drawings to the Mechanical/Plumbing Contractor for his use to provide formal submittal for coordinated shop drawing. These CADD Drawings must be submitted to Mechanical Contractor within 3 weeks from Letter of Intent. This submission will consist of all MEP trades and coordination of structural steel and metal stud installations.

- The Sitework Contractor will be responsible for removing all concrete pads that are outside of the building footprint. All MEP equipment, power and control wiring and piping on these pads will be removed by the responsible MEP trade.

- Provide concrete equipment pads, curbs and thrust blocks for fire protection work.

- Provide all testing and inspections.

- Provide cutting and patching.

- Provide firesafing.

- Provide design.

- Provide coordination with architectural ceiling installations to confirm center of tile installations.

- Flow and tamper switches to be supplied by this Contractor and wired by the Electrical Contractor. It is this Contractors responsibility to provide flow and tamper switches to meet applicable state and local codes.

- Provide system in attic (Glycol).

- Provide attic system in existing building only. No sprinkler system is required in above ceiling areas in addition.

- Provide air compressor for dry system piping.

- Provide daily fine clean up of the work is the responsibility of each individual Contractor which includes broom cleaning of their debris as required. Daily Fine clean up on a daily basis shall be defined as those means/methods utilized to perform the daily cleaning tasks without producing dust, noise and stacking of stored materials. All debris must be removed from the building at the end of each work day.

- Provide meter, if required, and all applicable fees.

- Provide pipe identification.

- The Demolition Contractor will provide demolition of slabs as indicated for file storage system and large areas in and adjacent to mechanical work. The Mechanical Contractor must coordinate with other MEP trades, but is responsible for shoring, dewatering and installation of specified systems, and backfill to top of subgrade. The Concrete Contractor shall provide new slab on grade after backfilling has been inspected. The Mechanical Contractor shall provide demolition and to return SOG to correct grades work at the Bathroom slabs.

- Provide fire main from +/- 5′-0″outside building including connection in the building. The site contractor will complete the underground work from +/-5′-0″
- This contractor shall include all supports needed to maintain dry system in attic space. The hangers are to be 5′-0″ o.c. max and do not bend or distort existing framing members.
- Coordinate and provide center of tile or center of panel design.
- Provide the necessary coordination with trade to avoid interferences with other work and make corrections at no extra charge.
- Provide as-built drawings..
- Coordinate the penetrations with the Roofing Contractor trades so that penetrations align with seams. No seams will be allowed to be penetrated for any MEP installations.
- Provide splash block for sprinkler washout locations.
- This Contractor shall include a $3,000 allowance in base bid. This allowance is to only be utilized by the Construction Manager.
- This contractor shall provide alternate pricing as requested on the bid form.

"FOR REFERENCE ONLY"

CONTRACT NO. B-14 - MECHANICAL AND PLUMBING

A. Work included in this contract consists of, but is not necessarily limited to, all labor, materials and equipment for:

- Technical Specification sections:

Division 0	Bidding and Contract Requirements
Division 1	General Requirements
Section 012500	Substitution Procedures
Section 013300	Submittal Procedures
Section 017700	Closeout Procedures
Section 017419	Construction Waste Management and Disposal
Section 017900	Demonstration and Training
Section 018113	Sustainable Design Requirements
Section 019113	General Commissioning Requirements
Section 083113	Access Doors & Frames
Section 220500	Common Work Results for Plumbing
Section 220516	Expansion Fitting and Loops for Plumbing Piping
Section 220517	Sleeves and Sleeve Seals for Plumbing Piping
Section 220518	Escutcheons for Plumbing Piping
Section 220519	Meters & Gages for Plumbing Piping
Section 220523	General Duty Valves for Plumbing Piping
Section 220529	Hangars and Supports for Plumbing Piping and Equipment
Section 220553	Identification for Plumbing Piping and Equipment
Section 220719	Plumbing and Piping Insulation
Section 221113	Facility Water Distribution
Section 221116	Domestic Water Piping
Section 221119	Domestic Water Piping Specialties
Section 221316	Sanitary Waste and Vent Piping
Section 221319	Sanitary Waste Piping Specialties
Section 221423	Storm Drainage Piping Specialties
Section 221623	Facility Natural-Gas Piping
Section 223300	Electric, Domestic-Water Heaters
Section 224213.13	Commercial Water Closets
Section 224213.16	Commercial Urinals
Section 224213.13	Commercial Lavatories
Section 224216.16	Commercial Sinks
Section 224713	Drinking Fountains/Water Dispensers
Section 230000	General Requirements Mechanical & Electrical
Section 220120	Water System Cleaning
Section 230500	Common Work Results for HVAC
Section 230513	Common Electrical Requirements for HVAC Equipment

Section 230516	Expansion Fittings and Loops for HVAC Piping
Section 230519	Meters & Gauges for HVAC Piping
Section 230523	General-Duty Valves for HVAC Piping
Section 230529	Hangars and Supports for HVAC Piping Equipment
Section 230553	Identification for HVAC Piping and Equipment
Section 230700	HVAC Insulation
Section 230800	Commissioning Plan – Construction Phase
Section 232113	Hydronic Piping
Section 232113.33	Ground Loop Heat Pump Piping
Section 232123	Hydronic Pumps
Section 232900	Variable Frequency Motor Controllers
Section 233100	Air Ducts
Section 233300	Air Duct Accessories
Section233400	HVAC Fans
Section 233600	Air Terminal Units
Section 233700	Air Inlets and Outlets
Section 235100	Breeching, Chimneys, and Stacks
Section 235216	Condensing Boilers
Section 236500	Closed Circuit Cooler
Section 237200	Air to Air Energy Recovery Equipment
Section 238126	Split System Heat Pump Units
Section 238146	Water Source Unitary Heat Pumps
Section 238200	Terminal Heating and Cooling Units
Section 237400	Packaged Outdoor, Central-Station Air Handling Unit
Section 238200	Thermal, Heating and Cooling Units

This contract also includes, but is not necessarily limited to, all labor, materials and equipment for the following:

- Provide a complete mechanical, plumbing and piping system as indicated on the Drawings and in the Specifications.

- All of the specifications should be reviewed as it relates to the power wiring and other requirements for HVAC equipment including the coordination of furnishing and installing motor starters as provided in the specifications.

- The Sitework Contractor will be responsible for removing all concrete pads that are outside of the building footprint. All MEP equipment, power and control wiring and piping on these pads will be removed by the responsible MEP trade.

- This Contractor shall be responsible to designate an individual within his organization, intimately familiar with this project and assigned on site, to act as the System Start-up Coordinator. This individual must be pre-approved by the Construction Manager. This individual's responsibilities shall include, but not be limited to, coordinating the start-up of all mechanical equipment, including the coordination between the Electrical

Contractor, the Controls Contractor, and all testing, adjusting and balancing work. This individual shall report on a weekly basis, in written form, to the Construction Manager. These reports shall include a summary of current conditions including manufacturers' start-ups, systems' deficiencies noted to date and the remediation of same, coordination issues between trades, system interfacing and forecasting, as necessary to project the completion of each individual system within the building.

- Excavation and backfill for underground mechanical/plumbing work as detailed below is the responsibility of this Contractor. Soil types shall be in accordance with Del Dot standard specifications. Refer to Division 2 specifications.
- Backfilling is the responsibility of this Contractor. Soil types shall be in accordance with project documents.
- Provide equipment bases and housekeeping pads.
- Provide permits/meters.
- Provide pipe and duct insulation.
- Provide penetrations through wall, floors, etc. including cutting, patching and fire safing.
- Testing, adjusting and balancing will be completed by the TAB contractor. This contractor will need to provide and coordinate with TAB & Controls Contractor.
- All guarantees and warranties to begin at the substantial completion of the entire project. Maintain equipment prior to substantial completion.
- Provide hoisting, rigging and scaffolding.
- ATC will be completed by Controls Contractor. This contractor will need to provide and coordinate with TAB & Controls Contractor.
- Provide ductwork, flex duct, grilles and diffusers.
- Provide roof drains.
- Provide daily fine clean up of the work is the responsibility of each individual Contractor which includes broom cleaning of their debris as required. Daily Fine clean up on a daily basis shall be defined as those means/methods utilized to perform the daily cleaning tasks without producing dust, noise and stacking of stored materials. All debris must be removed from the building at the end of each work day.
- Provide louvers and vents related to HVAC operations.
- Coordinate damper size, location and type of damper with architectural drawings.

- Temporary heat and ventilation installation, maintenance and removal. Refer to Division 1, Specification section 015123 - TEMPORARY HEAT AND VENTILATION, for specific scope.

- Provide gas piping, meter and pressure regulator valve.

- Electric baseboard heat.

- Trap priming system.

- Provide curbs and/or rails as needed for provided equipment.

- Water meter pit shall remain

- All utilities will be brought to within +/- 5 feet of the building line by the Sitework Contractor. The Mechanical Contractor is responsible for connecting the utilities from +/- 5 feet outside the building line and completing the system within the building.

- Install Owner prepurchased equipment, if applicable.

- Provide access panels as needed for HVAC & plumbing installations.

- Provide as-built drawings.

- Coordinate and provide cadd version of coordinated shop drawings that includes all MEP trades and coordination of structural steel and metal stud installations. This drawing must be fully submitted within 4 weeks of award of contract.

- Provide installation plumbing and mechanical installations of appliances. Appliances are to be supplied by the Carpentry & General Works Contractor.

- The Demolition Contractor will provide demolition of slabs as indicated for file storage system and large areas in and adjacent to mechanical work. The Mechanical Contractor must coordinate with other MEP trades, but is responsible for shoring, dewatering and installation of specified systems, and backfill to top of subgrade. The Concrete Contractor shall provide new slab on grade after backfilling has been inspected. The Mechanical Contractor shall provide demolition and to return SOG to correct grades work at the Bathroom slabs.

- The Roofing Contractor shall provide capping details at existing exhaust fans as shown. This contractor shall be responsible for modifying duct and exhaust fans as indicated.

- The Concrete Contractor shall furnish, install and maintain stone fill under slab. The Sitework Contractor shall leave the building pad site at subtgrade to within +/- ¼" in

preparation to receive stone fill. The Mechanical and Electrical Contractors shall complete their work under the slab on grade and shall be responsible to return the pad to the subgrade elevation left by the Sitework Contractor. The Concrete Contractor shall then adjust the select material to final subgrade, fine grade the slab and place the vapor barrier and stone fill.

- Coordinate the penetrations with the Roofing Contractor trades so that penetrations align with seams. No seams will be allowed to be penetrated for any MEP installations

- This Contractor shall include a $5,000 allowance in base bid. This allowance is to only be utilized by the Construction Manager.

- This contractor shall provide alternate pricing as requested on the bid form.

"FOR REFERENCE ONLY"

CONTRACT NO. B-15 – TESTING ADJUSTING & BALANCING

A. Work included in this contract consists of, but is not necessarily limited to, all labor, materials and equipment for:

- Technical Specification sections:

Division 0	Bidding and Contract Requirements
Division 1	General Requirements
Section 230593	Testing, Adjusting and Balancing for HVAC
Section 230800	Commissioning Plan – Construction Phase

This contract also includes, but is not necessarily limited to, all labor, materials and equipment for the following:

- Contractor shall provide all labor materials and equipment needed to provide a complete water and air system balancing.

- This contractor shall complete and provide documentation that all specified testing has been completed and that system demonstrate all equipment performs properly.

- All closeout training must be videoed and copies are to be sent with documents.

- Performs all testing and balancing as per SMACNA standards and specifications.

- Provide certified balancing report within 2 weeks of completion of work.

- Provide fine clean up on a daily basis. Fine cleaning shall be defined as those means/methods utilized to perform the daily cleaning tasks without producing dust, odors, noise or dust.

- This contractor shall assume multiple visits will be required to complete this work. It is the intent that all come back work and out of sequence work will be included in the base bid of this project.

- Provide cadd version of drawings to the Mechanical/Plumbing Contractor for his use to provide formal submittal for coordinated shop drawing. This submission will consist of all MEP trades and coordination of structural steel and metal stud installations.

- All conduits and sleeve penetrations from floor to floor must be made with boots that extend higher that the concrete curb heights on each floor. All sleeves must be caulked and sealed as required.

- Provide field notes for Engineer's review within two days of performing the balancing.

- Coordinate the penetrations with the Roofing Contractor trades so that penetrations align with seams. No seams will be allowed to be penetrated for any MEP installations

- This contractor shall provide alternate pricing as requested on the bid form.

CONTRACT NO. C-02 - AUTOMATIC TEMPERATURE CONTROLS

A. Work included in this contract consists of, but is not necessarily limited to, all labor, materials and equipment for:

- Technical Specification sections

Division 0	Bidding and Contract Requirements
Division 1	General Requirements
Section 012500	Substitution Procedures
Section 013300	Submittal Procedures
Section 017700	Closeout Procedures
Section 017419	Construction Waste Management and Disposal
Section 017900	Demonstration and Training
Section 018113	Sustainable Design Requirements
Section 019113	General Commissioning Requirements
Section 230500	Common Work Results for HVAC
Section 230513	Common Motor Requirements for HVAC Equipment
Section 230519	Meters and Gages for HVAC Piping
Section 230529	Hangars & Supports for HVAC Piping and Equipment
Section 230553	Identification for HVAC Piping and Equipment
Section 230593	Testing Adjusting & Balancing for HVAC
Section 230800	Commissioning Plan – Construction Phase
Section 230950	Building Automation System (BAS) General
Section 230951	BAS Basic Materials, Interface Devices and Sensors
Section 230953	BAS Field Panels
Section 230954	BAS Communication Devices
Section 230955	BAS Software and Programming
Section 230958	BAS Sequence of Operations
Section 230959	BAS System Commissioning
Section 232113	Hydronic Pumps
Section 232900	Variable Frequency Motor Controllers
Section 233400	HVAC Fans
Section 235216	Condensing Boilers
Section 236500	Closed Circuit Cooler
Section 237200	Air to Air Energy Recovery Equipment
Section 238126	Split System Heat Pump Units
Section 238146	Water Source Unitary Heat Pumps
Section 238200	Terminal Heating and Cooling Units
Section 260500	Common Work Results for Electrical
Section 260519	Low-Voltage Electrical Power Conductor Cables
Section 260526	Grounding and Bonding for Electrical Systems
Section 260529	Hangars and Supports for Electrical Systems
Section 260533	Raceways and Boxes for Electrical Systems
Section 260544	Sleeves and Sleeve Seals for Electrical Raceways and Cabeling

Section 260553	Identification for Electrical Systems
Section 262713	Electrical Metering
Section 262726	Wiring Devices
Section 262816	Switches and Enclosed Breakers
Section 262913	Enclosed Breakers
Section 283111	Digital, Addressable Fire Alarm System

This contract also includes, but is not necessarily limited to, all labor, materials and equipment for the following:

- Automatic temperature controls for equipment whose main purpose include all items in the automatic temperature control scope. Provided, however, that the controls do not directly switch the power lines to the equipment; the wiring of such controls to remain the responsibility under Contract Scope.

- Provide all environmental controls.

- Provide ventilation controls.

- Provide cooling controls.

- The Sitework Contractor will be responsible for removing all concrete pads that are outside of the building footprint. All MEP equipment, power and control wiring and piping on these pads will be removed by the responsible MEP trade.

- Provide humidification controls.

- Provide daily fine clean up of the work is the responsibility of each individual Contractor which includes broom cleaning of their debris as required. Daily Fine clean up on a daily basis shall be defined as those means/methods utilized to perform the daily cleaning tasks without producing dust, noise and stacking of stored materials. All debris must be removed from the building at the end of each work day.

- Provide motorized dampers when not specified as part of the factory packaged equipment supplied to job site for distribution and installation by others.

- Provide controls air compressor complete with accessories and insulation.

- Provide remote reading gauges, transmitters and recorders for automatic temperature controls.

- Provide building centralization controls including centralized temperature, humidity, pressure and flow indication and recorders, centralization of air conditioning, heating, ventilation, humidification and refrigeration equipment operation.

- Provide building life safety control and equipment safety control including: operators and controls for motorized smoke dampers, operators and controls for motorized fire dampers, firestats, freeze protection thermostats, shut down safety devices forming part of automatic temperature control.

- Provide any permits as required for work under this contract scope.

- Provide all inspections as required under this contract scope.

- Provide electrical thermostats intended for automatic temperature controls complete with subbases or adapter plates to mount on standard electrical box.

- Provide remote reading gauges, transmitters and recorders for automatic temperature control.

- The Demolition Contractor will provide demolition of slabs as indicated for file storage system and large areas in and adjacent to mechanical work. The Mechanical Contractor must coordinate with other MEP trades, but is responsible for shoring, dewatering and installation of specified systems, and backfill to top of subgrade. The Concrete Contractor shall provide new slab on grade after backfilling has been inspected.

- Provide access doors required for access to automatic temperature control.

- Provide control wiring and/or air piping required for all automatic temperature controls supplied under this contract scope.

- Provide wiring for remote thermostats and remote prewired auxiliary control panels for packaged equipment.

- Provide boiler feed water control wiring.

- Provide cadd version of drawings to the Mechanical/Plumbing Contractor for his use to provide formal submittal for coordinated shop drawing. These CADD Drawings must be submitted to Mechanical Contractor within 3 weeks from Letter of Intent. This submission will consist of all MEP trades and coordination of structural steel and metal stud installations.

- Power wiring will be provided by others.

- Control power supply outlets will be provided by others.

- This contractor shall provide alternate pricing as requested on the bid form.

"FOR REFERENCE ONLY"

CONTRACT NO. B-17 - ELECTRICAL

A. Work included in this contract consists of, but is not necessarily limited to, all labor, materials and equipment for:

- Technical Specification sections:

Division 0	Bidding and Contract Requirements
Division 1	General Requirements
Section 012500	Substitution Procedures
Section 013300	Submittal Procedures
Section 017700	Closeout Procedures
Section 017419	Construction Waste Management and Disposal
Section 017900	Demonstration and Training
Section 018113	Sustainable Design Requirements
Section 019113	General Commissioning Requirements
Section 083113	Access Doors & Frames
Section 230513	Common Electrical Requirements for HVAC Equipment
Section 230800	Commissioning Plan – Construction Phase
Section 260500	Common Work Results for Electrical
Section 260513	Medium Voltage Cables
Section 260519	Low-Voltage Electrical Power Conductor and Cables
Section 260526	Grounding and Bonding for Electrical Systems
Section 260529	Hangars and Supports for Electrical Systems
Section 260533	Raceway and Boxes for Electrical Systems
Section 260536	Cable Tray
Section 260543	Underground Ducts and Raceways for Electrical Systems
Section 260544	Sleeves and Seals for Electrical Raceways and Cabling
Section 260553	Identification for Electrical Systems
Section 260572	Overcurrent Protective Device Short-Circuit Study
Section 260573	Overcurrent Protective Device Coordination Study
Section 260574	Overcurrent Protective Device Arc-Flash Study
Section 262200	Low Voltage Transformers
Section 262416	Panelboards
Section 262713	Electricity Metering
Section 262726	Wiring Devices
Section 264313	Surge Protection for Low-Voltage Electrical Power Circuits
Section 265100	Interior Lighting
Section 265600	Exterior Lighting
Section 270526	Grounding and Bonding for Communications Systems
Section 270528	Cable Trays for Communications Systems
Section 270528.49	Telecommunications Cabling Systems Floorbox

Section 271000	Telecommunications Structured Cabling
Section 281300	Access Control Systems
Section 282300	Video Surveillance System
Section 283111	Addressable Fire-Alarm System

This contract also includes, but is not necessarily limited to, all labor, materials and equipment for the following:

- Provide a complete electrical system as indicated on the drawings, schedules and in the specifications.

- The specifications should be reviewed as it relates to the power wiring and other requirements for HVAC equipment including the coordination of furnishing and installing motor starters and controllers as detailed in the Specifications and on the Drawings.

- Provide excavation and backfill for underground electrical work as required below is the responsibility of this Contractor. Soil types shall be in accordance with Del DOT standard specifications.

- The Sitework Contractor will be responsible for removing all concrete pads that are outside of the building footprint. All MEP equipment, power and control wiring and piping on these pads will be removed by the responsible MEP trade.

- Backfilling is the responsibility of this Contractor. Soil types shall be in accordance with project documents.

- Provide concrete for duct banks, light standards, above ground conduit encasement, equipment bases and any other concrete work specifically related to the electrical work. Include requirements local and state codes for concrete encasement.

- Provide temporary electric installation, maintenance and removal. Refer to Division 1, specification section 015113 - TEMPORARY ELECTRIC, for specific scope.

- Provide rough in and final connection and related work for equipment provided under other contracts (i.e. kitchen, HVAC, sprinkler, etc.)

- Provide permits and inspections.

- Provide installation electric and switches if necessary for the installations of appliances. Appliances are to be supplied by the Carpentry & General Works Contractor.

- Provide penetrations through walls, floors, etc. including cutting, patching and fire safing.

- Provide testing.

- Provide daily fine clean up of the work is the responsibility of each individual Contractor which includes broom cleaning of their debris as required. Daily Fine clean up on a daily basis shall be defined as those means/methods utilized to perform the daily cleaning tasks without producing dust, noise and stacking of stored materials. All debris must be removed from the building at the end of each work day.

- The Concrete Contractor shall furnish, install and maintain stone fill under slab. The Sitework Contractor shall leave the building pad site at subgrade to within +/- ¼" in preparation to receive stone fill. The Mechanical and Electrical Contractors shall complete their work under the slab on grade and shall be responsible to return the pad to the subgrade elevation left by the Sitework Contractor. The Concrete Contractor shall then adjust the select material to final subgrade, fine grade the slab and place the vapor barrier and stone fill.

- All guarantees and warranties to begin at the substantial completion of the entire project. Maintain equipment prior to substantial completion.

- Provide hoisting, rigging and scaffolding.

- Provide all work associated with utility company related costs/fees for this work.

- Provide a complete fire alarm system. Water flow devices are supplied and installed by the Sprinkler Contractor and wired by this Contractor. Include tie-in to fire sprinkler flow and tamper switch.

- Heat tracing.

- Provide special systems (sound, security, etc.).

- Provide lightning protection with master UL certification. Provide coordination with Roofing Contractor.

- Provide grounding of building columns and interior spaces as required.

- Provide pull strings and boxes for voice/data boxes.

- Provide cadd version of drawings to the Mechanical/Plumbing Contractor for his use to provide formal submittal for coordinated shop drawing. These CADD Drawings must be submitted to Mechanical Contractor within 3 weeks from Letter of Intent. This submission will consist of all MEP trades and coordination of structural steel and metal stud installations.

- Provide rough-in and final connection and related work for equipment provided under other contracts (i.e. kitchen, HVAC, sprinkler, etc.). Provide power to automatic

hardware. Low voltage wiring from the controller to hardware shall be provided by the Doors, Frames and Hardware Contractor.

- Provide complete audio and audiovisual systems.

- Provide walker duct and underslab conduits and raceways as indicated.

- Provide rough-in and final connection of kitchen equipment and appliances. Coordinate power/plug requirements with rough in for equipment with the Kitchen Equipment Contractor.

- Provide public address system as noted.

- Provide all lighting, including the temporary housing and reinstallation of existing lighting that will be reinstalled.

- Provide as-built drawings.

- The Demolition Contractor will provide demolition of slabs as indicated for file storage system and large areas in and adjacent to mechanical work. The Mechanical Contractor must coordinate with other MEP trades, but is responsible for shoring, dewatering and installation of specified systems, and backfill to top of subgrade. The Concrete Contractor shall provide new slab on grade after backfilling has been inspected. The Mechanical Contractor shall provide demolition and to return SOG to correct grades work at the Bathroom slabs.

- Coordinate the penetrations with the Roofing Contractor trades so that penetrations align with seams. No seams will be allowed to be penetrated for any MEP installations

- All doors and hardware will be provided by the Carpentry & General Works Contractor. All electrical wiring, consistent with Electrical & TA drawings shall be provided by Electrical Contractor.

- This Contractor shall include a $5,000 allowance in base bid. This allowance is to only be utilized by the Construction Manager.

- This contractor shall provide alternate pricing as requested on the bid form.

END OF SECTION

SECTION 012100 - ALLOWANCES

1. RELATED DOCUMENTS

1.1 The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

1.2 Refer to provisions in AIA Document A232 – 2009 EDITION, GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION, CONSTRUCTION MANAGER AS ADVISOR EDITION, for requirements in addition to those specified in Division 1.

1.3 Refer to Scope Information Sheets for all contracts bound in the Project Manual under Section 011100 - SUMMARY OF WORK. The Scope Information Sheets describe generally the work included in each contract, but the work is not necessarily limited to that described.

1.4 For work being constructed under separate prime contracts, provisions of this Section apply to each contract being bid.

1.5 Include in the Contract Sum all lump sum and unit cost allowances stated in the Contract Documents.

1.6 Designate in the construction progress schedule the delivery dates for products specified under each allowance.

1.7 Designate in the Schedule of Values the quantities of materials required under each unit cost allowance.

2. ALLOWANCES FOR PRODUCTS

2.1 The amount of each allowance includes:

A. The cost of the product or labor to the Contractor or Subcontractor, less any applicable trade discounts.

B. Delivery to the site.

C. Labor required under the allowance, only when labor in specified to be included in the allowance. If labor is not specified to be included in the allowance, it shall be included in the Contractor's bid and in the resulting Contract Sum.

D. Applicable taxes.

E. Profit and overhead.

2.2 In addition to the amount of each allowance, include in the Contract Sum the Contractor's costs for:

A. Handling at the site; including unloading, uncrating and storage.

B. Protection from the elements and from damage.

C. Labor for installation and finishing, except where labor is specified to be a part of the allowance.

D. Other expenses required to complete the installation.

E. Contractor's and Subcontractor's overhead and profit.

2.3 Refer to Scope Information Sheets under Section 011100 - SUMMARY OF WORK for the amount of each lump sum allowance and for work specified in the specification sections listed below.

A. Section 02072: Provide labor under direction of CM.

3. ADJUSTMENT OF COSTS

3.1 Should the net cost be more or less than the specified amount of the allowance, the Contract Sum will be adjusted accordingly by Change Order.

A. For products and labor specified under a unit cost allowance, the unit cost shall apply to the quantities actually used with a nominal allowance for waste, as determined by receipted invoices, or by field measurement.

3.2 At Contract closeout, reflect all approved changes in Contract amounts in the final statement of accounting.

END OF SECTION

SECTION 012200 - UNIT PRICES

1. GENERAL PROVISIONS

1.1 The general provision of the Contract, including the Conditions of the Contract (General, Supplementary and other conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

1.2 Refer to provisions in AIA Document A232 – 2009 EDITION, GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION, CONSTRUCTION MANAGER AS ADVISOR EDITION, for requirements in addition to those specified in Division 1.

1.3 For work being constructed under separate prime contract, provisions of this Section apply to each contract being bid.

2. BASE BID

2.1 The Base Bid shall consist of all work shown or specified in the Contract Documents, exclusive of any Additive Unit Prices specified herein.

.2.2 The Base Bid shall include all work in any Subtractive Unit Prices specified herein.

3. UNIT PRICES

3.1 State in the Bid Form the amount to be added to (or subtracted from) the Base Bid per unit of measurement for each Unit Price specified. State this amount to include all overhead and profit. No surcharge in addition to the Unit Price listed will be permitted.

3.2 See Section 002113, INSTRUCTIONS TO BIDDERS for related information.

3.3 For description of Unit Prices requested, refer to the specification. The method of stating the Unit Prices is described in the Bid Form.

3.4 Where both add and deduct unit prices are requested, there shall not be more that a 10% variation between the two.

4. APPLICATION OF UNIT PRICES

4.1 Unit prices stated in the Bid Form will apply from the time the Bid is submitted until Contract completion.

5. MEASUREMENT OF QUANTITIES

5.1 Quantities shall be determined by field measurement by contractor personnel and as verified by the Construction Manager.

5.2 At the Contractor's option, and at his expense, measurement may be made by a registered surveyor.

6. LIST AND DESCRIPTION OF UNIT PRICES

UNIT PRICES

Unit prices conform to applicable project specification section. Refer to the specifications for a complete description of the following Unit Prices:

	TRENCH	Add	Deduct	BULK Add	BULK Deduct
1.	Price per cubic yard for rock excavation as specified in excavation section.	_____	_____	_____	_____
2.	Price per cubic yard for earth excavation as specified in excavation section.	_____	_____	_____	_____
3.	Price per cubic yard for earth excavation by hand.	_____	_____	_____	_____
4.	Price per cubic yard for reinforced concrete on grade	_____	_____	_____	_____

END OF SECTION

SECTION 012300 - ALTERNATES

1. GENERAL PROVISIONS

1.1 The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

1.2 Refer to provisions in AIA Document A232 – 2009 Edition, GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION, CONSTRUCTION MANAGER AS ADVISOR EDITION, for requirements in addition to those specified in Division 1.

1.3 For work being constructed under separate prime contracts, provisions of this Section apply to each contract being bid.

2. BASE BID

2.1 The Base Bid shall consist of all work shown or specified in the Contract Documents, exclusive of any Additive Alternates specified herein.

2.2 The Base Bid shall include all work in any Subtractive Alternates specified herein.

3. ALTERNATES

3.1 State in the Bid Form the amount to be added to the Base Bid for each Alternate specified.

3.2 See Section 002113 - INSTRUCTIONS TO BIDDERS for related information.

3.3 The description of Alternates contained herein is in summary form. Detailed requirements for materials and execution shall be as specified in other sections and as shown on drawings.

ALTERNATES

None

END OF SECTION

SECTION 012600 - CHANGE ORDER PROCEDURES

1. GENERAL:

1.1 The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

1.2 Refer to provisions in AIA Document A232 – 2009 EDITION, GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION, CONSTRUCTION MANAGER AS ADVISOR EDITION, for requirements in addition to those specified in Division 1.

1.3 The Construction Manager is responsible for processing all change orders. Each request will be assigned a change order request (COR) number. The Change Order Request & Execution Form will be initiated via the web-based project management system (Building Blok) used by the CM.

1.4 It is to be clearly understood that no extra work shall commence without an approved written and executed change order from the Owner.

2. INITIATING A CHANGE ORDER:

2.1 Specific changes initiated by the Owner, Architect, Construction Manager (CM) or Contractor will be processed as follows:

A. The Owner will authorize the Architect to prepare sufficient documents to establish an accurate price. These documents to be forwarded to the Construction Manager and Owner "for pricing only, not authorized for construction." The Construction Manager will develop the estimate (within 2 weeks) showing a breakdown by trades with all trade contractor quotes. The Owner will approve or reject the change request within two (2) weeks. If the Owner elects to proceed with the change, the Construction Manager will prepare formal change orders to the various trade contractors involved in the change and reference in all formal change orders the original change order request number.

B. Field Change: Contractor shall immediately notify the Construction Manager of a change due to field conditions or site conditions. If documents cannot be prepared for pricing due to schedule constraints, the Construction Manager will make every effort in estimating the field change. If the Owner and Construction Manager agree that certain field changes should be handled on a time and material basis, the Construction Manager will closely monitor the Contractor's labor and material affecting this change. At the completion of the work a formal change order will be issued.

C. Contractor Change: If a Contractor initiates a change order for work not included in the Contract, the Construction Manager and Architect will research the validity of the request, verify quantities and pricing and submit to the Owner for approval on a

change order request.

2.2 The additional cost, or credit to the Owner resulting from a change in the Work shall be by mutual agreement of the Owner, Contractor, Construction Manager and the Architect.

3. PROCESSING A CHANGE ORDER:

3.1 The Contractor will fill in the Change Order Request & Execution Form (COREF) with a brief description of the change, any time extension, and cost changes.

3.2 The Contractor will attach to the COREF copies of the written quotations from the trade contractors, Contractors, and suppliers. The Labor Detail Sheet and the Change Order Detail forms must be added as an attachment to the COREF. The Contractor and each sub-tier contractor (as applicable) must fill out the Labor Detail Sheet and Change Order Detail Sheet. Samples of these forms are attached.

3.3 In all cases, this cost or credit shall be based on the "DPE" wages required and the "invoice price" of the materials/equipment needed.

3.4 "DPE" shall be defined to mean "direct personnel expense". Direct payroll expense includes direct salary plus customary fringe benefits (prevailing wage rates) and documented statutory costs such as workman's compensation insurance, FICA, and unemployment insurance.

A. "Fringe Benefit" is any medical, life or disability insurance, paid time off, etc.

B. "Worker's Compensation" is the insurance required for injuries including medical leave, etc.

C. "FICA" is the costs association with Social Security and Medicare insurance.

D. "Unemployment insurance" is the cost associated with the governmental assessment for employee's unemployment benefits.

3.5 "Invoice price" of materials/equipment shall be defined to mean the actual cost of materials and/or equipment that is paid by the Contractor (or Subcontractor) to a material distributor, direct factory vendor, store, material provider, or equipment leasing entity.

3.6 In addition to the above, the Contractor is allowed markup for overhead and profit on additional work performed as outlined in Specification Section 012613, Contractor Compensation.

3.7 Building Blok Procedures: The Contractor will submit all change order requests and supporting documentation via the Building Blok web-based project management system. Each Contractor will be issued a unique login and password. Each contractor must

submit the information as follows:

A. Create a new change order, from your "To-Do List" by clicking on the "Create Issue" tab in the upper right corner and select "Change Order Request".

B. The Contractor will enter a brief description of the change in the "Summary" block. A detailed description of the change will be entered in the "Description of Change" block, to include any changes to documents or time extension. The cost of the change will be entered in the "Total Cost Change" block.

C. The Labor Detail Sheet and the Change Order Detail forms must be added as an attachment to the request. The Contractor and each sub-tier contractor (as applicable) must fill out the Labor Detail Sheet and Change Order Detail Sheet. Samples of these forms are included behind this section. In addition to these forms, the Contractor also must attach any material and equipment rental quotations. All of these documents should be scanned and saved as a PDF file. Click on the "Browse" box to upload the file. Be sure to wait until Building Blok tells you the file was "Uploaded Successfully".

D. Once the information is entered on the form and the proper attachments are uploaded, the contractor will click "Save". The Contractor will be prompted to enter their password to approve an electronic signature. Once you save the request you will have an opportunity to check it before submitting it to the CM. After you verify the COREF is correct click "Recommend Approval" to submit the change request to the CM. The Contractor will then be prompted to re-enter the password to approve an electronic signature and complete the submission request. Click on "Home" in the upper left corner to make sure the change order does not appear on your To-Do List.

E. The Change Order Request will then be reviewed by the CM Project Manager and Recommended for Approval, Rejected, or returned to the Contractor for additional information. Once the Construction Manager, Owner, and Architect have approved the request all parties will receive an email from Building Blok notifying them that a fully executed Change Order and Contract Recalculation Form can be downloaded from Building Blok. Hard copies of the executed change order and recalculation form will not be provided by the CM.

3.8 All COR's will need to be submitted in hard copy format after they have been approved on BB, as the State still requires all COR's to be submitted after Building Blok approval and all signatures must be real. No facsimile signatures will be accepted.

It is to be clearly stated that no extra work shall commence without an approval from the **Owner or Construction Manager** or Owner's representative.

END OF SECTION

CHANGE ORDER REQUEST & EXECUTION FORM

110 South Poplar Street
Suite 400
Wilmington, DE 19801

Tel. 302-421-5700
Fax 302-421-5715

DATE:	PROJECT NAME: DTCC – Office of President
CONTRACT:	REQUEST NUMBER:
CONTRACTOR:	CHANGE ORDER NUMBER:
	STATE PO NUMBER:

The following is a summary of the request submitted by the contractor as described above. All supporting documents have been attached and described herewith. This summary shall contain a total amount of compensation requested by the contractor as well as any request for an extension in contract time. It shall be understood that the amounts described below shall remain valid for a period of sixty days from the date described above unless otherwise stated.

A detailed breakdown of Labor, material, equipment, and subcontract costs must be attached to be considered for review.

1. Summary Description(s):
2. Changes to the Contract Drawings:
3. Changes to the Project Manual:
4. Total Cost Change:
5. Total Time Change:

REVIEWED

This request has been reviewed and____approval_____disapproval is recommended by:

Name Title Date

APPROVED

This change order request is not approved until executed by all parties bound by a contractual relationship. Upon execution it shall represent a modification to the agreement and is subject to all terms and conditions of the contract documents.

Contractor:	Architect:
Signed By:	Signed By:
Title:	Title:
Date:	Date:
EDiS Company	Owner:
Signed By:	Signed By:
Title:	Title:
Date:	Date:

CHANGE ORDER DETAIL FORM

(Provided by contractor, subcontractor or sub tier contractor)

DATE SUBMITTED:

CONTRACT:

CONTRACTOR:

PROJECT NAME:

CHANGE ORDER REQUEST #:

LABOR SECTION

TRADESMAN(s):	LABOR HOURS	RATE (per schedule)	SUBTOTAL
Subtotal			

MATERIAL SECTION

MATERIAL:	QUANTITY	UNIT COST	SUBTOTAL
Subtotal			

EQUIPMENT SECTION

EQUIPMENT:	QUANTITY	UNIT COST	SUBTOTAL
Subtotal			

SUBTOTAL	
SUBCONTRACTOR/ SUB TIER*	
OH & PROFIT (10% on sub/sub tier only))	
BOND COST	
OH & PROFIT (15% on own work)	
GRAND TOTAL	

LABOR DETAIL FORM

(Provided by contractor, subcontractor, or sub-tier contractor)

DATE:

CONTRACT:

CONTRACTOR:

PROJECT NAME:

CHANGE ORDER REQUEST #:

CLASSIFICATION:			
Base Wage Rate:			
Health Insurance			
Holidays			
Sick Days			
Life Insurance			
Disability Insurance			
Dental Insurance			
Company Vehicle			
401K			
Education			
Other (*specify below*)			
Subtotal			
Posted Prevailing Rate			
FICA (Social Security & Medicare)			
SUTA (State Unemployment)			
FUTA (Federal Unemployment)			
General Liability Insurance			
Worker's Compensation			
Total Wage Rate			

3/2012

SECTION 012613 - CONTRACTOR COMPENSATION

1. GENERAL

1.1 The Contractor agrees to perform any additional Work, for the net cost of materials and labor (including wages paid, payroll taxes, and all insurance) plus the following percentage for all of his overhead and profit, which includes Field Supervision:

The percentages to be added or allowed for any Work change involving both added Work and omitted Work shall be applied only to the net difference in cost.

(a) 15% mark-up (10% overhead and 5% profit) by the Contractor on Work performed by his own forces.

(b) For work done by a Subcontractor, 10% for subcontractor overhead and 5% for subcontractor profit to which the Contractor may add 7.5% for his overhead and profit combined.

(c) Contractor mark-up shall include supervision, home and field overhead, all self-owned small tools and equipment.

1.2 When the Contractor is directed to perform overtime work at the CM (Owner) expense to accelerate contractual work, the cost for same shall only be the actual premium costs incurred by the Contractor.

END OF SECTION

SECTION 012900 - PAYMENT PROCEDURES

1. GENERAL PROVISIONS

   1.1 The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

   1.2 Refer to provisions in AIA Document A132 - 2009 Edition, GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION, CONSTRUCTION MANAGER AS ADVISOR EDITION, for requirements in addition to those specified in Division 1.

   1.3 For work being constructed under separate prime contracts, provisions of this Section apply to each contract being bid.

2. REQUIREMENTS INCLUDED

   2.1 Submit Applications for Payment to Construction Manager in accordance with the schedule and procedures established in the Contract Documents.

3. RELATED REQUIREMENTS

   3.1 Owner-Contractor Agreement.

   3.2 Conditions of the Contract: Article 9 PAYMENTS AND COMPLETION.

   3.3 Section 01 31 13: Project Coordination Meetings

   3.4 Section 01 33 00: Submittal Procedures

   3.5 Section 01 77 00: Closeout Procedures

4. FORMAT AND DATA REQUIRED

   4.1 Submit itemized applications typed on AIA Document G702/CMa, Application and Certificate for Payment, and Continuation Sheet G703, examples of which will be furnished to the Contractor at the Pre-Construction meeting.

   4.2 Provide itemized data on Continuation Sheet:

      1. Format, schedules, line items and values: Duplicates of those of the schedule of values previously accepted by the Construction Manager.

5. PREPARATION OF APPLICATIONS FOR PROGRESS PAYMENTS

5.1 Form: AIA Document G702/CMa

1. Fill in required information, including that for Change Orders executed prior to date of submittal of application.

2. Fill in summary of dollar values to agree with respective totals indicated on Continuation Sheets.

5.2 Continuation Sheets:

1. Line items of components of Work will be subject to Owner's review and approval under the Provisions of Section 013300 - SUBMITTALS, and the General Conditions. Continuation Sheets shall follow Schedule of Values submitted at the start of the job.

2. Fill in total list of all scheduled components of Work, with item number and scheduled dollar value for each item. Fill in values of work completed in the period.

3. Fill in dollar value in each column for each scheduled line item when work has been performed or products stored; round off values to nearest dollar.

4. List each Change Order executed prior to date of submission, at the end of the Continuation Sheets; list by Change Order Number, and description, as for an original component item of work.

6. PREPARATION OF APPLICATION FOR FINAL PAYMENT

6.1 Fill in Application form as specified in progress payments.

7. SUBMITTAL PROCEDURES

7.1 Complete Invoice:

1. Submit completed Application to the Construction Manager by the date stipulated in the Project Manual.

7.2 Number: Submit 3 copies of each invoice.

END OF SECTION

SECTION 013113 - PROJECT COORDINATION MEETING

1. PROJECT COORDINATION MEETING

   1.1 An on-site project coordination meeting will be held on a biweekly basis throughout the project construction period.

2. ATTENDANCE

   2.1 Attendance at the project coordination meeting is mandatory of each Contractor or major supplier on the project.

   2.2 The representative of the Contractor shall be the Project Manager and field superintendent, unless a substitute representative has been approved by the Construction Manager.

   2.3 Contractor will begin attending the Project Coordination Meetings at least 4 weeks prior to mobilization on site, and will continue until the Contractor has fulfilled the obligations of his Contract.

3. AGENDA

   3.1 The Construction Manager will set the agenda for the biweekly Project Coordination Meeting.

   3.2 At a minimum, the Contractor shall be prepared to discuss the following:

      1. Actual vs. as planned progress for the prior two week period.
      2. Planned construction activities for the next four weeks.
      3. Contract document clarifications.
      4. Coordination items with other contractors.
      5. Quality Control.
      6. Recently issued change orders.
      7. Potential change orders.
      8. Submittals and shop drawings.
      9. Other items requiring Construction Manager's attention.

END OF SECTION

SECTION 013119 – PRE-INSTALLATION MEETINGS

1. PRE-INSTALLATION MEETINGS

1.1 An on-site pre-installation meeting will be held at least two weeks prior to commencement of installation of work.

2. ATTENDANCE

2.1 Attendance at the pre-installation meeting is mandatory of each Contractor and/or major supplier as required for each specific meeting listed below.

2.2 The following individuals shall attend these meetings:
- Contractors' Project Manager
- Contractors' Field Superintendent
- Contractors' Safety Representative (as needed)
- Key Subcontractors, Suppliers, and Vendors
- EDiS Project Manager
- EDiS Field Manager
- EDiS Safety Director (as needed)
- EDiS MEP Specialist (as needed)
- Owner's Representative (as needed)
- Architect/Engineer (as needed)
- Governmental Agency Representatives (as needed)
- Testing/Inspection Agency Representatives (as needed)
- Utility Company Representatives (as needed)

3. SUBMITTALS

3.1 Each contractor is responsible to have all submittals and mock-ups, as related to the pre-installation meeting scope of work, submitted and approved prior to commencement of the pre-installation meeting.

4. LIST OF REQUIRED MEETINGS

- Fire Protection
  - Fire Sprinkler Systems
  - Fire Alarm Systems
- MEP Coordination
  - Mechanical Piping Rough-in
  - Plumbing Rough-in
  - Insulation
  - Electrical Rough-in
  - Electrical – Bonding, grounding, lightning protection
  - Automatic Temperature Controls
  - Testing Adjusting & Balancing
  - Commissioning

- Voice/Data Low Voltage Wiring
- Security System
- Audio-Visual Equipment

5. AGENDA

3.1 At a minimum, the Contractor shall be prepared to discuss the items as listed on the agenda template shown on the following page:

PROJECT: _____
PRE-INSTALLATION MEETING : (Insert Phase of Work)

A. ATTENDEES:

NAME	COMPANY	WORK ITEM	CONTRACT

B. TESTING & INSPECTION REQUIREMENTS ***(THESE REQUIREMENTS COME FROM THE PROJECT MANUAL)***

C. REVIEW CONTRACT DRAWINGS AND SPECIFICATIONS

Drawing / Spec No.	Comments / Conflicts

D. REVIEW SCOPES OF WORK *(SEE SECTION 011100 IN THE PROJECT MANUAL)*

E. REVIEW RELEVANT RFI'S

F. REVIEW SUBMITTALS *(SEE THE SUBMITTAL REGISTER)*

G. REVIEW MATERIALS AND DELIVERIES

H. REVIEW SCHEDULE AND SEQUENCE OF WORK

I. JOB SITE SAFETY *(SEE THE CONTRACTOR'S SAFETY PROGRAM OR OSHA)*

- Safety Plans must be submitted before the start of work
- Certificates of Insurance need to be submitted before the start of work
- Minimum PPE – Hardhats, steel toe boots, safety glasses
- Lock-out, Tag, Test and Try ALL utilities is critical before the start of demolition
- Signage & HAZCOM Requirements
- Potential Hazards
    - Excavations >4 ft
    - Slips/trips/falls
    - Existing utilities to remain and protected
    - Overhead debris
    - Power tools
    - Heavy equipment

J. COORDINATION WITH OTHER TRADES

K. ACTION ITEMS AND RESPONSIBILITY

END OF SECTION

SECTION 013125– WEB-BASED PROJECT MANAGEMENT SYSTEM

1. GENERAL PROVISIONS

1.1 The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

1.2 Refer to provisions in AIA Document A201 – 2007 EDITION, GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION, for requirements in addition to those specified in Division 1.

1.3 Refer to Scope Information Sheets for all contracts bound in the Project Manual under Section 011100 - SUMMARY OF WORK. The Scope Information Sheets describe generally the work included in each contract, but the work is not necessarily limited to that described.

1.4 All Contractors shall use Internet/Web-based project management software to transmit documents, track, and otherwise manage this project.

1.5 Use of this project management software will not change any contractual responsibilities of the construction team members.

2. DEFINITIONS

2.1 System: A real time web-based software that shares data, translates data, organizes data, facilitates communication, archives actions, and offers scheduling prompts to identified Users.

2.2 Users: Authorized participants of this project furnished with a unique password and authorized to access the system to view/input/export data. Owner, Construction Manager, Architect, and the Contractors are all Users. Other Users may be added as necessary.

2.3 Contacts: Entities identified to automatically receive specific transmissions or entities selected to receive specific information sent by the system through to an e-mail address.

2.4 Signees: Those individuals identified, by the Contractors, authorized to sign change orders and payment applications via electronic signature. This electronic signature is as contractually binding as an original signature on paper.

3. USE OF SYSTEM

3.1 The use of the system is mandatory for the documentation of the transmittal of all non-oral information, even if the actual transmission of the information is by another means.

3.2 The use of the system will be mandatory by the Contractors to send, retrieve, and respond to data.

3.3 In addition to this web-based project management system, the Contractors will be required to use electronic mail (email) for day-to-day communication and correspondence. Email will be the primary means of transmitting written communication (i.e. meeting minutes, draft pay applications, etc.).

4. QUALITY ASSURANCE

4.1 A three hour training session in the use of the software for this project will be offered by the Construction Manager at a location convenient to the project site. Attendance by one member of each Contractor's organization is mandatory. Additional attendees may enroll based on availability of training space. All attendees must have a working knowledge of computers. Training can not begin until three working days after the receipt of the submittals indicated below.

4.2 Technical assistance will be provided by on-line help, email, or telephone for all Users throughout the life of the project.

5. SUBMITTALS

5.1 Submit to the Construction Manager, within 5 days following the receipt of the letter of intent to award, in an electronic template, the following:

a. Electronic logo of organization (as needed)
b. Names, mailing address and electronic address of its Users and Contacts.
c. Designation the role/responsibility for each User

6. SOFTWARE AND HARDWARE REQUIREMENTS

6.1 Each User shall provide and maintain a computer with high speed internet access and an email address. The computer shall have a high speed internet browser (Internet Explorer 8.0 or higher, Firefox version 3.6.12 or higher, Google Chrome or Safari version 5.0 or higher) and a high speed cable Internet access, high speed DSL or T1 line.

6.2 License(s) to Use System - Each Contractor will be provided unlimited licenses to use the system for this project. Each license will allow secure unlimited usage from the notice to proceed until the original contract completion date.

7. SYSTEM DESCRIPTION

7.1 The web based project management system is a "secure, real-time, interactive, centralized database" specifically established and maintained for the management of this construction project. The product is designed to facilitate communication and improve the time management of its users by facilitating the sharing of information. Information will be available 24/7, from any computer meeting the specifications listed above. The information is fully protected. The

electronic platform allows information to be transmitted across the internet reducing printing and postage costs and the time associated with such activities.

7.2 The system contains a directory of the project participants.

7.3 The system includes templates, with the CM's letterhead, for each document created inside the system. The template allows the use of "pull down" menus to complete significant portions of each document.

7.4 The system allows the templates (and attached documents created outside the system) to be distributed to Users and Contacts.

7.5 The System contains "translation software" to permit the viewing (and marking) of documents created outside the system. The system can view documents created by different software programs and can deliver images of its translation to any computer meeting the criteria listed above.

7.6 The system can be personalized by the Construction Manager to automatically send e-mail notices upon issuance of certain documents if such a practice facilitates the User's business needs.

7.7 The system is the product of ***Building Blok LLC*** (www.buildingblok.com) and will be continuously updated.

7.8 The Construction Manager will administer the Building Blok User accounts for this project.

8. <u>DOCUMENTS CREATED INSIDE THE SYSTEM</u>

8.1 The following documents shall be created on templates inside the system.
   a. Transmittals for submittals processed in the system. The transmittals are automatically created by the system when the submittal is uploaded.
   b. Submittal Register showing all of the submittals required of the contract, assigned to each Contractor.
   c. Submittal Log: The CM will maintain submittal log after it is initialized.
   d. RFI (Requests for Information)
   e. Change Orders
   f. RFP (Requests for Proposal)
   g. ASI (Architect's Supplemental Instructions)
   h. Tasks & Memos as determined by the CM
   i. Payment Applications
   j. Closeout Tracking Log

8.2 The following documents may, at each Users option, be created on the system.
   a. Morning & Afternoon Activity Reports generated by the system
   b. E-mails: Contacts that do not have access to the system may be sent information from the

system, by the system.

c. Reports of information on the system
d. Project Notices: "Broadcast" messages can be sent to other Users system entry screen.

9. DOCUMENTS CREATED OUTSIDE THE SYSTEM AND DISTRIBUTED BY THE SYSTEM

9.1 The following documents are expected to be created outside the system and distributed through the system. The actual documents may be scanned or electronically attached to the transmittal.

a. Technical Submittals: Shop drawings, product data, testing reports, certifications, installation instructions, operation & maintenance manuals, will be submitted and distributed through the system. The Architect will return all submissions through the system electronically. The Construction Manager will distribute submittals (after Architect's action) electronically. Contractors may download and distribute submittals to their subcontractors and suppliers or elect to print paper copies for distribution, or both.
b. Photographs: Digital photographs and scanned images can be loaded onto the system and shared.
d. Schedule of Values/ Payment Applications: (The "pencil" review of these documents can occur inside the system).
e. Change Orders: (The "pencil" review of these documents can occur inside the system.)
g. Schedules: The schedule document(s) will be available for review on the system.
h. Data created in other software may be uploaded to the system electronically.

10. DOCUMENTS CREATED OUTSIDE THE SYSTEM AND DISTRIBUTED OUTSIDE THE SYSTEM

10.1 The following documents are expected to be created outside the system and distributed outside the system. The actual documents may be scanned or electronically attached to the transmittal.

a. Schedules: The Construction Manager will develop the Master Schedule through Microsoft Project 2003. The schedule will be distributed either through hard copies at meetings or through email.
b. Product samples, color samples, physical samples are still required to be provided per the technical specifications, however, the transmittal documenting the distribution shall be done inside the system and submitted electronically and printed to accompany the actual submission.
c. Meeting minutes will be created using Microsoft Word 2003 and distributed through hard copies at meetings or through email.
d. AIA closeout documents, which require an "original" signature, will created and distributed outside the system.

END OF SECTION

SECTION 013216 - CONSTRUCTION SCHEDULE

1. PRE-BID CONSTRUCTION SCHEDULE

1.1 Time is a critical element of this Project. By entering a bid, the Contractor agrees to adhere to the intermediate Milestone Dates and Dates of Substantial and Final Completion established herein. The Contractor also understands that all work must be performed in an orderly and closely coordinated sequence in order to achieve the specified Milestones and Completion Dates, and the Contractor hereby agrees to perform his work in conformance with the Pre-Bid Construction Schedule established herein, or with the then current and approved Project Construction Schedule as amended from time to time by the Construction Manager.

1.2 The Pre-Bid Construction Schedule includes allowances for time lost due to adverse and abnormal weather conditions, other than floods, hurricanes, tornadoes, lightening and other like acts of God. The Contractor understands and agrees that it shall not be entitled to any extensions of the Contract Time or adjustment to the Contract Sum, except as allowed in the General Conditions of the Contract for Construction. The Contractor further acknowledges that the Work may be required to be performed during the winter season, that conditions during this season may be adverse and abnormal, but that such conditions will not be the basis for an extension of the Contract Time or adjustment to the Contract Sum.

2. SCHEDULING OF THE WORK AFTER AWARD OF CONTRACT

2.1 After award of Contract, or issuance of a Notice to Proceed, the Contractor will meet with the Construction Manager to review the Pre-Bid Construction Schedule, and the overall project plan for construction. Following the above review the Contractor will meet with each subcontractor and supplier to view the detailed plans for performing his Work. Following these meetings and within fourteen (14) days after award of the Contract or issuance of a Notice to Proceed, the Contractor shall prepare and submit for the Construction Manager's approval a Work Schedule providing for the expeditious, timely and practical execution of the Work. The Contractor's Work Schedule shall include activity descriptions and durations for shop drawings, fabrication, delivery and installation. If the Construction Manager so requests, the Contractor shall provide adequate explanation regarding crew sizes, production rates and similar data used to arrive at the durations and sequences.

2.2 The Construction Manager shall review the Contractor's Work Schedule, coordinate it with the separate work by other contractors, the Owner and the Construction Manager, and after coordination, shall incorporate it into the approved Project Construction Schedule. The approved Project Construction Schedule shall be issued to the Contractor and the Contractor shall perform his Work in conformity therewith.

2.3 The Contractor shall submit proposed schedule revisions and obtain the written

approval of the Construction Manager therefore before deviating from the Project Construction Schedule.

2.4 The Construction Manager will incorporate approved schedule revisions into the Project Construction Schedule, and shall otherwise update and revise the Project Construction Schedule as the Construction Manager, at his sole discretion, deems necessary.

3. ADHERENCE TO THE SCHEDULE

3.1 The Contractor shall start each part of its Work on the date designated for start in the approved Project Construction Schedule unless advised by the Construction Manager. The Contractor shall carry the Work forward expeditiously with adequate forces, equipment and materials, and shall complete each part of his work on or before the date designated in the approved Project Construction Schedule.

3.2 If the Construction Manager determines that the Contractor is behind schedule, the Construction Manager shall have the right to require that the Contractor take steps, at the Contractor's expense, to accelerate its Work. Such steps shall include increases in manpower, equipment and materials and/or overtime as the Construction Manager may deem necessary. If the Contractor fails to comply with the Construction Manager's instructions relating to improved rate of progress, the Contractor may be held in default under the appropriate provisions of the General Conditions of the Contract.

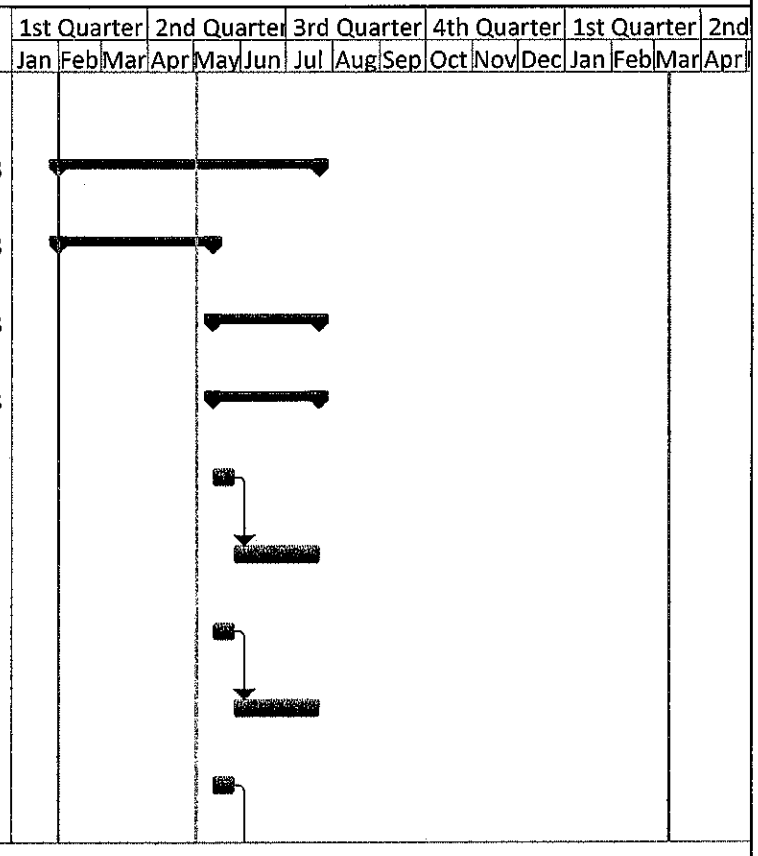
3.3 Each Contractor shall, if directed by the Construction Manager, provide the Construction Manager a 2-week look ahead of anticipated manpower showing the number of men, classification, and anticipated work.

END OF SECTION

EDiS Company
DTCC - Office of the President

DTCC Bid Pac "C" Bid Schedule

ID	Task Name	Duration	Start	Finish
1				
2	**Construction Bidding Phase**	**122 days?**	**Fri 2/1/13**	**Mon 7/22/13**
3	**Bidding Requirements**	**72 days?**	**Fri 2/1/13**	**Mon 5/13/13**
11	**Critical Long Lead Items**	**50 days?**	**Tue 5/14/13**	**Mon 7/22/13**
29	**Mechanical Submittals & shop drawings**	**50 days**	**Tue 5/14/13**	**Mon 7/22/13**
30	Boiler	2 wks	Tue 5/14/13	Mon 5/27/13
31	Boiler Lead Time	8 wks	Tue 5/28/13	Mon 7/22/13
32	Cooling Tower (Base Bid)	2 wks	Tue 5/14/13	Mon 5/27/13
33	Cooling Tower Lead Time	8 wks	Tue 5/28/13	Mon 7/22/13
34	Geothermal (Alternate)	2 wks	Tue 5/14/13	Mon 5/27/13

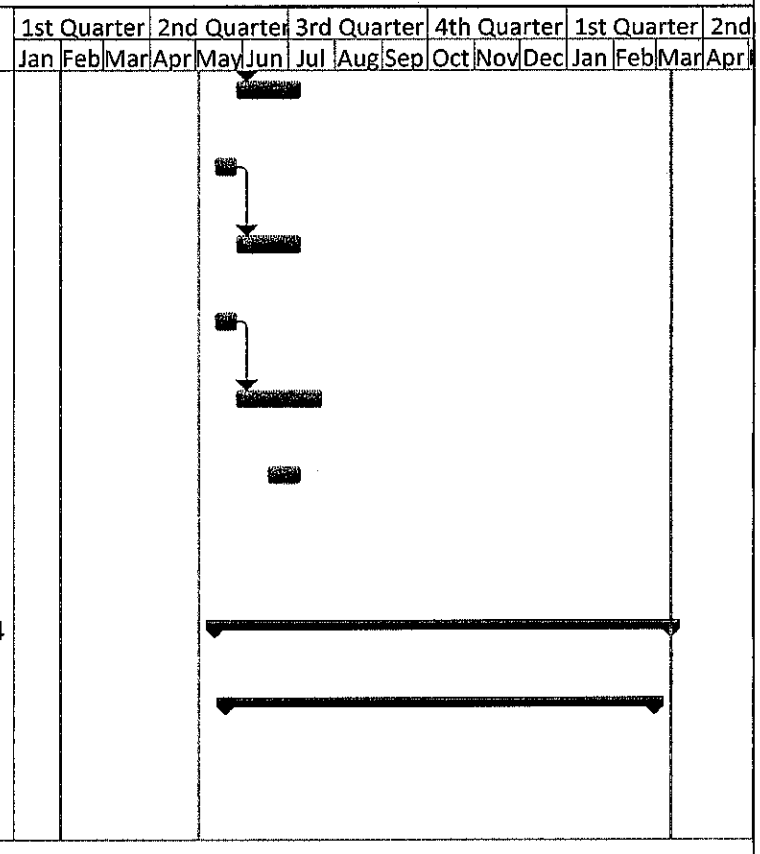


Task		External Milestone		Manual Summary Rollup	
Split		Inactive Task		Manual Summary	
Milestone		Inactive Milestone		Start-only	
Summary		Inactive Summary		Finish-only	
Project Summary		Manual Task		Deadline	
External Tasks		Duration-only		Progress	

EDiS Company
DTCC - Office of the President

DTCC Bid Pac "C" Bid Schedule

ID	Task Name	Duration	Start	Finish
35	Geothermal Well Lead Time (Alternate)	6 wks	Tue 5/28/13	Mon 7/8/13
36	Heat Pumps	2 wks	Tue 5/14/13	Mon 5/27/13
37	Heat Pump Lead Times	6 wks	Tue 5/28/13	Mon 7/8/13
38	Electrical Gear	2 wks	Tue 5/14/13	Mon 5/27/13
39	Electrical Gear Lead Times	8 wks	Tue 5/28/13	Mon 7/22/13
40	Sprinkler Shop Drawing & Submittals	3 wks	Tue 6/18/13	Mon 7/8/13
41				
42	**Construction Phase of Project**	**215 days**	**Tue 5/14/13**	**Mon 3/10/14**
43	**Sitework**	**203 days**	**Tue 5/21/13**	**Thu 2/27/14**
59				

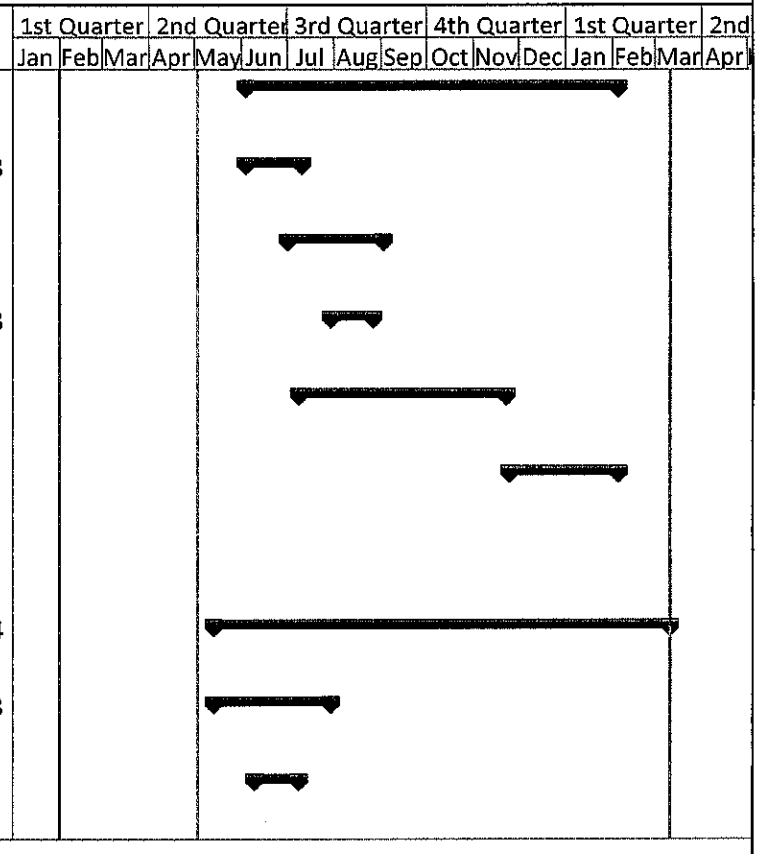


Task		External Milestone		Manual Summary Rollup	
Split		Inactive Task		Manual Summary	
Milestone		Inactive Milestone		Start-only	
Summary		Inactive Summary		Finish-only	
Project Summary		Manual Task		Deadline	
External Tasks		Duration-only		Progress	

EDiS Company
DTCC - Office of the President

DTCC Bid Pac "C" Bid Schedule

ID	Task Name	Duration	Start	Finish
60	**New Addition**	**176 days**	**Tue 6/4/13**	**Tue 2/4/14**
61	**Foundations**	**27 days**	**Tue 6/4/13**	**Wed 7/10/13**
68	**Building Envelope**	**45 days**	**Tue 7/2/13**	**Mon 9/2/13**
77	**Interior Construction**	**20 days**	**Tue 7/30/13**	**Mon 8/26/13**
82	**MEP Rough-In**	**99 days**	**Tue 7/9/13**	**Fri 11/22/13**
95	**Finishes**	**52 days**	**Mon 11/25/1:**	**Tue 2/4/14**
109				
110	**Renovation & Entrance Addition**	**215 days**	**Tue 5/14/13**	**Mon 3/10/14**
111	**Selective Demolition**	**55 days**	**Tue 5/14/13**	**Mon 7/29/13**
118	**Foundations**	**21 days**	**Mon 6/10/13**	**Mon 7/8/13**

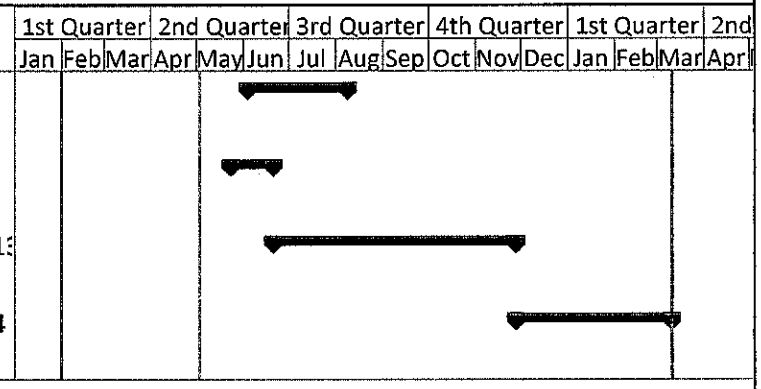


Task		External Milestone		Manual Summary Rollup	
Split		Inactive Task		Manual Summary	
Milestone		Inactive Milestone		Start-only	
Summary		Inactive Summary		Finish-only	
Project Summary		Manual Task		Deadline	
External Tasks		Duration-only		Progress	

EDiS Company
DTCC - Office of the President

DTCC Bid Pac "C" Bid Schedule

ID	Task Name	Duration	Start	Finish
122	**Building Envelope**	**48 days**	**Tue 6/4/13**	**Thu 8/8/13**
136	**Interior Construction**	**20 days**	**Fri 5/24/13**	**Thu 6/20/13**
139	**MEP Rough-In**	**114 days**	**Fri 6/21/13**	**Wed 11/27/1:**
152	**Finishes**	**73 days**	**Thu 11/28/13**	**Mon 3/10/14**



Task		External Milestone		Manual Summary Rollup	
Split		Inactive Task		Manual Summary	
Milestone		Inactive Milestone		Start-only	
Summary		Inactive Summary		Finish-only	
Project Summary		Manual Task		Deadline	
External Tasks		Duration-only		Progress	

SECTION 013219 - SUBMITTAL REGISTER

1. SUBMITTALS/SUBMITTAL REGISTER

1.1 The Contractor shall submit all items listed or specified within the sections of the Specifications included in its Work. Submittals shall include such items as: contractor's, manufacturer's or fabricator's drawings; descriptive literature including, but not limited to, catalog cuts, diagrams, operation charts or curves; test reports; samples, operations and maintenance manuals, including parts lists; certifications; warranties and other required submittals. Submittals pertinent to materials and equipment which are subject to advance approval shall be scheduled and made prior to the acquisition or the delivery thereof.

1.2 The Contractor shall carefully control procurement operations to assure that each individual submittal is made on or before the dates required for timely performance of its Work.

1.3 Within seven (7) days after award of Contract or issuance of Notice to Proceed, the Contractor shall execute and submit to the Construction Manager, seven (7) copies of the Submittal Register, on a form to be provided by the Construction Manager, on which shall be listed each item of equipment and material of each type for which fabricator's drawings and/or related descriptive data, test reports, samples, spare parts, operation and maintenance manuals, or other types of submittals required by the Specifications. The Submittal Register form shall be reproduced by the Contractor. The order of listing of items on the Register shall conform to the sequence of the items as they occur within the divisions. Drawings of component items forming a system or that are interrelated shall be scheduled to be correlated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time shall be allowed for review and approval and possible resubmittal of any item subject to approval, because no delay damages or time extensions will be allowed for time lost in late submittals or resubmittals. The Construction Manager and Architect/Engineer will review the Submittal Register for approval action. The approved Register will become a part of the Contract and Contractor will be subject to requirements thereof. The Contractor shall revise and/or update the Register monthly to take into account all changes in the Contract. Each such revised edition and/or revision to the Register shall be resubmitted to the Construction Manager. This Register shall be coordinated with related submittals of other Contractors.

2. SAMPLES

2.1 Submit tagged or labeled samples in triplicate, unless another quantity is otherwise specified by the Construction Manager.

2.2 Tags or labels shall be securely affixed and contain as a minimum the following information: Project Name, Contractor's Name, Contract Title and Number, Date, Transmittal Number, Product Manufacturer's or Fabricator's Name and Product Identifier.

END OF SECTION

SECTION 013226 - SUBCONTRACTOR DAILY REPORTS

1. SUBCONTRACTOR DAILY REPORTS

1.1 The Subcontractor shall submit a Daily Report to the Construction Manager on the forms provided covering the following subjects:

1. Work in Progress, including areas where work is being performed, nature of the operations in progress, and the manpower assigned.

2. Extra Work (Time and Material) in progress.

3. Materials Received.

4. Trade labor breakdown including identification of all workers on site and the number of hours (or portions thereof) worked by each.

5. ***Inspection Checklist (performed daily).***

1.2 The Subcontractor shall submit the Daily Report to the Construction Manager by 9:00 AM on the next workday following the workday covered in the Daily Report.

2. DAILY EXTRA WORK REPORT

2.1 The Subcontractor shall submit on the form provided a Daily Extra Work Report on each day he performs authorized Extra Work on a time and material basis.

2.2 A separate Daily Extra Work Report shall be submitted for each separate authorized Extra Work item done on a time and material basis.

2.3 The Subcontractor shall submit his Daily Extra Work Report as an attachment to his Daily Report by 9:00 AM on the next workday following the workday covered in the Daily Extra Work Report.

3. Sample Daily Report

3.1 A sample daily report follows this section for your reference.

END OF SECTION

EDiS COMPANY

CONTRACTOR'S DAILY REPORT

Project Name: DTCC – Office of the President

Date:

Contractor:

Contract No. & Description:

Weather:

Foreman's Name (Print)

TRADE	*CLASS	MANPOWER COUNT	TOTAL MAN HOURS	TODAY'S DESCRIPTION / LOCATION OF WORK
	TOTAL			

* *INDICATE: F = FOREMAN; J = JOURNEYMAN; A = APPRENTICE*

Work Status/Work Planned:

Construction Equipment:

Qualified Operator(s)

Deliveries or Materials:

Machinery, tools, material, and equipment to be used:

Inspection of work area, machinery, tools, material, or equipment

The use of any machinery, tool, material, or equipment which is not in compliance with any applicable requirement Is prohibited. Such machine, tool, material or equipment shall either be identified as unsafe by tagging or locking The controls to render them inoperable or shall be physically removed from its place of operation.

Please See Other Side

Below is a general checklist of requirements on this project. Contractors will check off items that pertain to their contract and project tasks. Notify EDiS Field Manager of any issues. This checklist is not meant to be all inclusive. Please refer to additional OSHA regulations for compliance.

House Keeping

- ☐ Material Storage Area's Orderly
- ☐ Trash Containers Available and Emptied daily
- ☐ Fire Hazards
- ☐ Lighting and ventilation
- ☐ Exits and Stair clear passage
- ☐ Walkways, corridors clear passage
- ☐ Daily debris /trash removal
- ☐ _____

Personal Protective Equipment

- ☐ Hard Hats being worn
- ☐ Safety Glasses with side shields being worn
- ☐ Secondary Eye/Face protection
- ☐ Respirators as required
- ☐ Hand protection when needed
- ☐ Ear protection when needed
- ☐ Inspected & Maintained
- ☐ _____

Fire Prevention

- ☐ Fire extinguishers inspected
- ☐ Flammable / Combustibles properly store
- ☐ Approved Fuel cans used and labeled
- ☐ Oxygen / Acetylenes stored properly
- ☐ _____

Electrical

- ☐ GFI in use
- ☐ Three prong insulated extension cords used
- ☐ Extension cords in good condition
- ☐ Lockout / Tag-out program in use
- ☐ _____

Excavations

- ☐ Miss Utility been contacted
- ☐ Properly Barricaded
- ☐ Ladders in use at depths over 4'-0"
- ☐ Ladders every 25'-0" distance
- ☐ Shored, sloped, benched as required
- ☐ Dewatering as needed
- ☐ _____

Ladders

- ☐ Good condition
- ☐ Correct pitch
- ☐ Extends 3'-0" above landing
- ☐ Open and secured / tied off
- ☐ _____

Scaffolds

- ☐ Certified Scaffold Installer
- ☐ Guardrails, toe boards, and planking secured
- ☐ Appropriate signage
- ☐ Adequate cross bracing
- ☐ Secured to building over 25'-0" in height
- ☐ _____

Cranes

- ☐ Rated Load Capacity available in cab
- ☐ Swing Radius barricaded
- ☐ Appropriate certificates / decals / hand signals
- ☐ Daily safety inspection log completed
- ☐ _____

Fall Protection

- ☐ Fall protection plan on file
- ☐ Full harness / shock absorbing lanyard used
- ☐ Anchoring points secured
- ☐ Perimeter barricades
- ☐ Open sided floor protection
- ☐ 6'-0" Tie-off utilized
- ☐ _____

Paperwork

- ☐ MSDS Information
- ☐ Contractors Safety Program
- ☐ Hazardous Communications Training
- ☐ Hazardous Communications Program
- ☐ Contractor Qualified Representation
- ☐ _____

Other

- ☐ _____
- ☐ _____

Foreman / Competent Person:

Print Name_____

Delaware Technical Community College
Office of the President
Bid Package 'C'

EDiS COMPANY

CONTRACTOR SUBMITTAL FORM

Contractor: **Contract #:**_____

Project Name: DTCC – Office of the President

To:

The following submittal (s) for the Architect's Review and Approval:

[ ] Shop Drawings [ ] Product Data [ ] Samples [ ] Samples [ ] Other (Identify)_____

[ ] Design Data [ ] Calculations [ ] Certificates [ ] Coordination Drawings [ ] Reports

[ ] Qualification Statements [ ] Other (Identify)_____

No. of Copies	Date	Submittal Number	Spec. Section #	Description of Submittal Items	Requested Return Date	EDIS Submittal Number (by EDIS)

Deviations from Contract Documents requirements are identified as follows:_____
_____

Remarks:_____

We hereby certify that _____(Contractor)_____has reviewed and approved submittals transmitted herewith for compliance and conformance with requirements of the Contract Documents.

Signed:_____ **Date:**_____

PU09, Revised 5/11

SECTION 013300 – SUBMITTAL PROCEDURES

1. GENERAL PROVISIONS

1.1 The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

1.2 All Product Data, Shop drawings, submissions for preconstruction and closeout requirements are to be submitted to EDiS via EDiS' Proprietary web based program called Building Blok. All contractors will be required to utilize all submissions for all aspects of construction including, but not limited to submittals, payment applications, change orders, safety requirements, daily work logs, etc.

2. ITEMS TO BE SUBMITTED AT START OF WORK

2.1 Performance/Labor and Material Payment Bond(s): One (1) copy of each bond simultaneously with the signed Agreement. See General Conditions Article 11.4 and Supplementary Conditions.

2.2 Policies or Certificates of Insurance: Two (2) copies simultaneously with the signed Agreement. See General Conditions Article 11 and Supplementary Conditions.

2.3 Contractor's License: Submit a copy of all business licenses required by local and state agencies.

2.4 Contractor's Schedule of Values: Two (2) copies for approval within 21 days after the Agreement is signed. See General Conditions Article 9.2 and provisions in this Section.

2.5 Contractor's Progress Schedule: Two (2) copies for review and reference within 21 days after the Agreement is signed. See General Conditions Article 3.10 and provisions in this Section.

2.6 Submittal Schedule: Two (2) copies for review and reference within 21 days after the Agreement is signed. See provisions in this Section.

2.7 Products List: Two (2) copies for approval within 30 days after the Agreement is signed. See provisions in Section 016200 - MATERIAL AND EQUIPMENT.

3. NON-RESIDENT CONTRACTOR & SUBCONTRACTORS BONDS

3.1 Refer to requirements in Section 011100 - INSTRUCTIONS TO BIDDERS for filing of Surety Bonds with the Division of Revenue.

3.2 If such bonds are required on this project, it will be the responsibility of the Contractor to produce evidence to the Construction Manager that they have been filed, or if not required, to supply a notarized statement that they are not required. This must be done within seven (7) days after award of Contract and in any event before construction starts.

4. RELATED REQUIREMENTS

4.1 See Section 017700 - CONTRACT CLOSE OUT: for submittal requirements for Contract Close out.

5. SUBMITTALS

5.1 All submittals shall be directed to the Construction Manager in the manner directed by the Construction Manager, and paragraph 9 of this section. Contractor shall use the Contractor Submittal Form appended to this section.

5.2 Prepare a Submittal's Schedule for Shop Drawings, Product Data and Samples. Show:

1. The dates for Contractor's submittals.

2. The dates submittals will be required for Owner-furnished products.

3. The date approved submittals will be required from the Architect.

5.3 Should the Architect or Construction Manager elect to omit any items from the list of items to be reviewed, it shall not relieve the Contractor from compliance with the Contract Documents with regard to that item. In such instance, the Contractor may still elect to have submittals prepared for his own use without review by the Architect or Construction Manager.

6. SHOP DRAWINGS

6.1 Conform to provisions in General Conditions applying to Shop Drawings.

6.2 Present in a clear and thorough manner.

1. Identify details by reference to sheet and details, schedule or room numbers shown on Contract Drawings.

2. Maximum sheet size: 30" x 42".

7. PRODUCT DATA

7.1 Conform to provisions in General Conditions applying to Product Data.

7.2 Preparation:

1. Clearly mark each copy to specifically identify products or models pertinent to project.

2. Show performance characteristics and capacities.

3. Show dimensions and clearances required.

4. Show wiring or piping diagrams and controls.

7.3 Manufacturer's standard schematic drawings and diagrams:

1. Modify drawings and diagrams to delete information which is not applicable to the Work.

2. Supplement standard information to provide information specifically applicable to the Work.

8. SAMPLES

8.1 Conform to provisions in General Conditions applying to Samples.

8.2 Provide samples of sufficient size and quantity to clearly illustrate:

1. Functional characteristics of the project, with integrally related parts and attachment devices.

2. Full range of color, texture and pattern.

8.3 Field samples and mock-ups; See requirements, if any, in other specification Sections.

9. SUBMITTAL REQUIREMENTS

9.1 Make submittals promptly through the Construction Manager in accordance with published schedule, and in such sequence as to cause no delay in the Work or in the Work of any other contractor.

9.2 Number of submittals required.

1. All Product Data, Shop drawings, submissions for preconstruction and closeout requirements are to be submitted to EDiS via EDiS' Proprietary web based program called Building Blok. All contractors will be required to utilize all submissions for all aspects of construction including, but not limited too

submittals, payment applications, change orders, safety requirements, daily work logs, etc.

9.3 Submittals shall contain:

1. The date of submission and the dates of any previous submissions.
2. The Project title and number.
3. Contract identification.
4. The names of the Contractor, Supplier and Manufacturer.
5. Identification of the product, with the specification section number.
6. Field dimensions, clearly identified as such.
7. Relation to adjacent or critical features of the Work or materials.
8. Applicable standards, such as ASTM or Federal Specification numbers.
9. Identification of deviations from Contract Documents.
10. Identification of revisions on resubmittals.
11. An 8 inch x 3 inch blank space for Contractor and Architect's stamps.
12. Contractor's stamp, initialed or signed, certifying review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the Work and of Contract Documents. Submittals which have not been stamped with this stamp or its approved equivalent will be returned without being reviewed.

9.4 Shop Drawing coordination and interface with work of other Contracts and adjacent work is the responsibility of each individual Contractor.

9.5 All submittals shall be accompanied by the contractor's submittal form, a copy of which is part of this section. The contractor's submittal form must be completed in its entirety by the contractor.

10. <u>RESUBMISSION REQUIREMENTS</u>

10.1 Make any corrections or changes in the submittals required by the Architect and resubmit until approved.

10.2 Shop drawings and Product Data:

1. Revise initial drawings or data, and resubmit as specified for the initial submittal.

2. Indicate any changes which have been made other than those requested by the Architect.

10.3 Samples: Submit new samples as required for initial submittal.

11. FINAL DISTRIBUTION OF APPROVED SUBMITTALS

11.1 The Construction Manager will receive and log submittals and forward to Architect after processing.

11.2 The Construction Manager will distribute copies of Shop Drawings and Product Data which carry the Architect's stamp to:

1. Contractor that made submittal.

2. Jobsite File.

3. Record Document File.

4. Other Contractors, as required for coordination.

11.3 The Construction Manager will distribute samples as required.

11.4 The Contractor will distribute copies of Shop Drawings and Product Data which carry the Architect's stamp to:

1. Subcontractors.

2. Suppliers.

3. Fabricators.

12. SCHEDULE OF VALUES

12.1 Use AIA Document G703, Continuation Sheet to G702.

13. PROGRESS SCHEDULE

13.1 Prepare schedules in the form of a horizontal bar chart.

1. Provide separate horizontal bar chart for each trade or operation.

2. Horizontal time scale: Identify the first work day of each week.

3. Scale and spacing: To allow space for notations and future revisions.

4. Minimum sheet size 11 inches by 17 inches.

13.2 Format of listings: The chronological order of the start of each item of work.

13.3 Show the complete sequence of construction by activity.

13.4 Show the dates for the beginning, and completion of, each major element of construction such as:

1. Site clearing.

2. Site utilities.

3. Foundation work.

4. Structural framing.

5. Subcontractor work.

6. Equipment installation.

13.5 Show projected percentage of completion for each item as of the first day of each month.

13.6 Update Progress Schedule monthly and submit with Application for Payment and Schedule of values.

13.7 Indicate progress of each activity to date of submission.

13.8 Show changes occurring since previous submission of schedule:

1. Major changes in scope.

2. Activities modified since previous submission.

3. Revised projections of progress and completion.

4. Other identifiable changes.

13.9 Provide a narrative report as needed to define:

1. Problem areas, anticipated delays and the impact of the schedule.
2. Corrective action recommended, and its effect.
3. The effect of changes on schedules of other prime contractors.

13.10 Submit one reproducible transparency.

13.11 After review, distribute copies of the schedule to:

1. Jobsite File.
2. Subcontractors.
3. Architect.
4. Owner.

13.12 Instruct recipients to report promptly to the Contractor, in writing, any problems anticipated by the projections shown in the schedules.

END OF SECTION

SECTION 013500 – CONTRACTOR EMPLOYEE BACKGROUND CHECK

1. It is the contractor's responsibility to perform background checks and screen all employees working onsite. The background check must include checking for a previous history of Child Abuse Convictions, Child Molestation Convictions, Felony Convictions, and Drug Convictions within the last 5 years. Any employee with any of these convictions may not enter the job site or the school campus. This background check must be completed and screened by the contractor prior to an employee entering the job site. The Construction Manager, The Owner's representative and the Owner have the right to request that the screening data be submitted on a case by case basis.

END OF SECTION

Delaware Technical Community College
Central Administration Building
Bid Package 'A'

CONTRACTOR

COMPETENT / QUALIFIED PERSON DESIGNATION LOG

Project: **Field Manager:**

Contract: Contrctor:	Applicable to Subcontractor (yes / no)		Foreman	Competent Person (if not foreman)
Subpart C-General Provisions				
1926-20 General Safety				
Subpart D - Health and Environmental Controls				
1926-53 Ionizing Radiation				
1926-55 Gases, Vapors, Fumes, Dusts, Mists				
1926-57 Ventilation				
1926.59 Hazard Communication				
1926.62 Lead				
Subpart E - Personal Protective Equipment				
1926.101 Hearing				
1926.103 Respirator Protection				
Subpart H - Materials Handling, Storage				
1926.251 Rigging Equipment for Material Handling				
Subpart J - Welding and Cutting				
1926.354 Welding, Cutting and Heating				
Subpart K - Electrical				
1926.404 Wiring Design and Protection				
Subpart L - Scaffolding				
1926.451 Scaffolding				
Subpart M - Fall Protection				
1926.502 Fall Protection Criteria and Practices				
1926.503 Training				
Subpart N - Cranes, Derrick -Redesignated 1926.1501				
Subpart O - Motor Vehicles and Equipment				
1926.601 Motor Vehicles				
Subpart P - Excavations				
1926.651 Specific Excavation Requirements				
1926.652 Requirements to Protective Systems				
Subpart S - Tunnels, Shafts, Caissons				
1926.800 Tunnels, Shafts, Caissons				
1926.803 Compressed Air				
Subpart T - Demolition				
1926.850 Preparatory Operations				
1926.852 Chutes				
1926.859 Mechanical Demolition				
Subpart V - Power Transmission and Distribution				
1926.955 Overhead Lines				

Delaware Technical Community College
Central Administration Building
Bid Package 'A'

Contract: Contrctor:	Applicable to Subcontractor (yes / no)		Foreman	Competent Person (if not foreman)
Subpart X - Stairways and Ladders				
1926.1053 Ladders				
1926.1060 Training Requirements				
Subpart Z - Toxic and Hazardous Substances				
1926.1101 Asbestos				
1926.1101 thru 1926.1148 Toxic and Hazardous Substances				

I certify that the listed employees are competent persons, as defined and required by specific OSHA standards. They are capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

Name (print)

Contractor Signature

Date

PU09, Revised 3/2012

SECTION 013523 - SAFETY PROGRAM

1. GENERAL

1.1 The Contractor shall be responsible for initiating, maintaining and supervising all safety activities and programs in connection with the Work.

1.2 Contractor shall be responsible for the safety of its personnel.

1.3 Hard hats and safety glasses must be worn by all personnel on the jobsite, except in contractor's administrative office/trailer. All equipment must comply with OSHA standards. All job site personnel shall wear long pants, shirts (no tank tops) and work boots.

2. SAFETY PROGRAM

2.1 Prior to commencing the Work, the Contractor shall submit to the Construction Manager (1) electronic copy and (1) bound copy of its safety program and one (1) copy of MSDS information in a 2" ringed notebook. One paper copy of the safety program and MSDS will be retained by the Construction Manager in the field office.

2.2 The safety program shall outline those hazards peculiar to the Contractor's Work, and the steps to be taken to eliminate or reduce the risk of injury or loss due to those hazards**. The program shall be site specific.** Contractor shall implement and enforce its safety program, which is in accordance with all OSHA, Federal, State and local laws.

2.3 Contractor shall designate a qualified Safety Supervisor to implement their safety program. Unless otherwise approved by the Construction Manager, the Safety Supervisor shall be the Contractor's Field Superintendent/Foremen.

2.4 Contractor shall furnish the names and qualifications of the competent persons and qualified persons who may be required for their scope of work by the Contractor's safety procedures, and by federal, state and/or local regulations. Examples include competent persons and/or qualified persons for steel erection, excavation, scaffold erection, confined space entry, crane and rigging operations, annual crane inspections, fall protection including horizontal lifeline systems, etc. See the attached Competent/Qualified Person Designation Log.

2.5 Contractor shall provide written certification showing that all employees have been trained on the Contractor's Safety Program. The written certification record shall contain the name or other identity of the employee trained, the date(s) of the training and the signature of the person who conducted the training or the signature of the employer. If the employer relies on training conducted by another

employer or completed prior to the effective date of this section, the certification record shall include the date the employer determined the prior training was adequate rather than the date of actual training. The employer shall instruct each employee in the recognition and avoidance of unsafe conditions and the regulations applicable to his work environment to control or eliminate any hazards or other exposure to illness or injury. Please forward certification (document) of training for each employee on an EDiS project. The latest training certificate shall be maintained.

2.6 Contractor shall provide certification of training on the following programs, as they pertain to your contract and project tasks: Scaffold, Fall Protection, Crane Operator, Signal Person, Crane Maintenance, Steel Erection Fall Protection, Respiratory Protection, Powder-Actuated Tools, and Motor Vehicles. Certification of training must include: Employee's name, date of training, person conducting the training, topics covered, and a statement that the student has successfully completed the course. This list is not meant to be all inclusive; please refer to OSHA regulations for applicable safety requirements.

2.7 Contractor Daily Reports with Safety Inspection Checklist will be submitted daily to Field Manager, verifying inspection of work area, machinery, equipment and tools.

2.8 Prior to starting work on-site, the Contractor shall arrange with the on-site Field Manager to have their employees complete the EDiS Company Zero Accidents Safety Orientation program.

2.9 Contractor shall hold weekly safety toolbox talks with all of its employees every Monday at 12:30 PM. The Contractor shall designate a responsible, capable person to conduct these meetings. Contractor's safety supervisor or superintendent must submit to the Construction Manager weekly toolbox talks attendance sheets and the topics discussed.

3. SUBSTANCE ABUSE POLICY STATEMENT

The Construction Manager is committed to providing a safe work site environment for its employees and Contractors' employees. The Construction Manager does not condone or permit employees and Contractors' employees to use or be under the influence of drugs or alcohol while they are on any of the Construction Manager's work sites. The Policy is as follows:

3.1 It is a violation of the Construction Manager's policy for employees and Contractors' employees to use, possess, sell, trade, or otherwise engage in the use of illegal drugs and alcohol.

3.2 It is a violation for employees and Contractors' employees to report to work while influenced by illegal drugs or alcohol.

3.3. It is a violation for employees and Contractors' employees to use prescription drugs illegally (i.e. to use prescription drugs that have not been legally obtained) and to use prescription drugs in a manner other than the prescribed intentions.

3.4 Employees and Contractors' employees who are taking medication, which is prescribed by their physician, are expected to discuss potential side effects with their prescribing physician, as it relates to the work requirements.

Violations of this policy will require disciplinary action. If any employees or Contractors' employees are observed or suspected of being influenced by drugs or alcohol, they will be instructed to stop work and may be required to leave the work site.

4. EXECUTION

4.1 Contractor shall comply with all applicable federal, state and local laws, regulations and orders relating to occupational safety and health, and related procedures, and shall, to the extent permitted by law, indemnify and hold Construction Manager, Owner and Architect, and their respective directors, officers, or agents and employees, harmless from any and all liability, public or private, penalties, contractual or otherwise, losses, damages, costs, attorney's fees, expenses, causes of action, claims or judgments resulting from a claim filed by anyone in connection with the aforementioned acts, or any rule, regulation or order promulgated thereunder, arising out of the Contractor's Work, this Agreement or any subcontract executed in prosecution of the Work. Contractor further agrees in the event of a claim of violation of any such laws, regulations, orders or procedures arising out of or in any way connected with the performance of this agreement, Construction Manager may immediately take whatever action is deemed necessary by Owner and/or Construction Manager to remedy the claim or violation. Any and all costs or expenses paid or incurred by Owner and/or Construction Manager in taking such action shall be borne by Contractor, and may be deducted from any payments due Contractor.

4.2 The Contractor agrees to (1) take all necessary steps to promote safety and health on the job site; (2) cooperate with Owner and/or Construction Manager and other Contractors in preventing and eliminating safety and health hazards: (3) train, instruct and provide adequate supervision to ensure that its employees are aware of, and comply with, applicable Federal and State safety and health laws, standards, regulations and rules, safe healthful work practices and all applicable safety rules, regulations and work practices and procedures (4) not create any hazards or expose any of its employees, employees of the Owner and/or Construction Manager or employees of Contractors to any hazards; and (5) where the Contractor is aware of the existence of a hazard not within its control, notify the Construction Manager of

the hazard as well as warn exposed persons to avoid the hazard.

4.3 The Contractor's Superintendent or Safety Supervisor shall immediately, verbally report, and promptly thereafter confirm in writing to the Construction Manager any unsafe conditions or practices that are observed, or violations of job safety which are not within the Contractor's control.

4.4 Contractors shall immediately, verbally report, and promptly thereafter confirm in writing, to the Construction Manager any unsafe practices or conditions that are observed which are not under the Contractor's control.

4.5 The Contractor's Superintendent or Safety Supervisor shall insure that adequate first aid supplies are available, and that personnel are qualified to administer first aid/CPR, as required by State and/or Federal regulations.

4.6 Contractor shall promptly notify Construction Manager of any personal injury requiring medical treatment of any of the Contractor's employees at the Project site; or of significant damage to property arising in connection with Contractor's performance, as promptly as possible after the occurrence of such injury or damage. Within twenty-four hours of such occurrence, Contractor shall furnish to Construction Manager a complete written report of such injury or damage.

4.7 Contractor certifies that the forgoing terms shall be made applicable to all Contractors' suppliers, materialmen or anyone furnishing labor and/or materials to the site.

4.8 The Contractor shall continue to educate his job Safety Supervisor or Superintendent of their responsibilities, which shall include:

1. Instructing workers and subcontractors under its supervision in safe work practices and work methods at the time they are given work assignments.

2. Ensuring that its workers and subcontractors have and use the proper protective equipment and suitable tools for the job.

3. Continuously checking to see that no unsafe practices or conditions are allowed to exist on any part of his job.

4. Acquainting its workers and subcontractors with all applicable safety requirements and seeing that they are enforced.

5. Setting a good example for his workers.

6. Making a complete investigation of accidents to determine facts necessary to take corrective action.

7. Promptly completing a "Supervisor's Investigation Form" with his Supervisor's assistance and distributing as required. This form will be provided by the Construction Manager.

8. Holding weekly "tool box" safety meetings with his men to:
   a. Discuss observed unsafe work practices or conditions including a review of current Construction Manager safety report.

   b. Review the accident experience of his crew and discuss correction of accident causes.

   c. Encourage safety suggestions from his men.

9. Seeing that prompt medical treatment is administered to an injured employee.

10. Correcting or reporting immediately to job superintendent any observed unsafe conditions, practices or violations of job security.

11. Making all reports required by these Contract Documents to the Construction Manager in a full and timely fashion.

5. SAFETY MEETINGS

5.1 The Contractor's Project Manager or Superintendent shall attend weekly or biweekly supervisory job meetings. The first topic of these meetings will be job site safety. The weekly safety reports will be reviewed and violations must be corrected immediately. Contractors will be encouraged to participate in the on-going jobsite safety.

6. TOOL BOX SAFETY MEETINGS

6.1 The Contractor shall schedule weekly "tool box" safety sessions to be held by his job safety supervisor or superintendent for all of his employees.

6.2 A member of the Contractor's management staff shall periodically attend "tool box" safety sessions to evaluate their effectiveness and offer any appropriate suggestions for improvement.

7. REPORTS

7.1 Contractors shall report all accidents or injuries on a timely basis in accordance with all applicable regulations.

7.2 Contractors shall promptly complete an accident investigation report of all accidents.

7.3 A record of all "tool box" safety sessions shall be made and submitted to the Construction Manager on forms to be provided.

8. SAFETY REPRESENTATIVE

8.1 The Construction Manager may employ the services of a Safety Representativ*e* on the project.

8.2 The Safety Representative *will* visit the job site on a weekly basis to determine if the work is being performed in a safe manner and in accordance with OSHA, State and Local safety regulations. Safety representative is not responsible for observing and documenting all possible safety violations. The Contractor's Safety Representative or Superintendent shall attend job site safety inspections with the Safety Representative on a weekly basis.

8.3 The Safety Representative will file a written report with the Construction Manager at the end of each inspection listing the safety violations observed during the inspection.

8.4 The Construction Manager will distribute the Safety Representative's report to all Contractors. All safety violations must be corrected immediately.

9. RIGHT TO STOP THE WORK DUE TO SAFETY VIOLATIONS

9.1 The Construction Manager, in its sole discretion, may order the Contractor to stop the work due to safety violations under the following circumstances:

1. If the Construction Manager observes the Contractor is violating safety regulations and the Contractor takes no immediate action to correct the violation.

2. If the Contractor has been notified by the Construction Manager in writing that he is in violation of safety regulations and fails to take action to correct the violation within 24 hours of the notice.

9.2 If the Construction Manager directs the Contractor to stop the work due to safety violation, it will be done in accordance with the General Conditions of the Contract. Contractor shall not be permitted an adjustment of the Contract Time or Sum for the days lost to any suspension of work.

9.3 If the Construction Manager or Safety Representative observes Contractor's employee violating this safety program or OSHA Standards in an habitual manner, or creating a serious life safety violation, the Construction Manager or Safety Representative may

instruct the Contractor's superintendent or foreman to remove the violator from the work site for failure to comply with the safety program and the contract.

10. EMERGENCY PROCEDURES

10.1 The Construction Manager shall establish a central meeting location for the assembly of all Contractors' employees in the event of a major job site emergency.

10.2 Contractor shall assemble all of their personnel and account for all employees. Contractor must immediately report to the Project Superintendent with the status of their employees.

11. FALL PROTECTION PROCEDURES

11.1 Contractor is responsible, in accordance with federal, state, local laws and regulations including OSHA, to provide and enforce their own site specific fall protection program and equipment. The following fall protection procedures shall be enforced by all Contractors as a minimum standard.

All workers on walking/working surfaces with unprotected sides or edges six feet (6') or higher above the next lower level must be protected from falls by the use of guardrail systems, net systems, fall arrest systems or control access zone programs. It is intended that when fall protection is required, it is required 100% of the time. All contractors are reminded that relevant industry regulations require that contractors comply with the following standards.

1. Workers constructing or working near leading edges must be protected.

2. Workers on the face of formwork or reinforcing steel must be protected at a height of 6 feet (6') or greater.

3. Scaffolds shall be guarded at 6 feet (6') above next lower level.

4. Brick layers performing overhand bricklaying and related work six feet (6') or higher above lower levels must be protected from falls.

5. Roofers must comply with OSHA standards for roof work.

6. The Contractor's controlled access zone plan shall be included in their site-specific safety program and shall be submitted prior to the start of work. Contractors are responsible for assuring programs are OSHA compliant.

7. Guidelines for Residential Construction or any interpretations will not be accepted in lieu of 1926 Standards.

8. Contractors must provide certification per OSHA CFR29 § 1926.503(b) of employee training and retraining on fall protection upon request.

11.2 Contractor shall provide its own fall protection. Fall protection may be provided by guardrail systems, net systems, or personal fall arrest systems. All fall protection systems must comply with OSHA standards.

11.3 Stepladders, exposed to shafts or edges of the building, greater than six feet (6') above the next lower level, must be tied off or otherwise secured. Employee must wear fall protection, i.e. harness/lanyard.

11.4 The Safety Cable System shall not be altered or removed without a written request submitted to the Project Manager with a copy to the Field Manager. It shall be the responsibility of each and every Contractor that is removing or altering the Safety Cable System to maintain the fall protection safety provided by the safety cable and not leave the area unprotected. Each and every Contractor shall be responsible to re-install the Safety Cable System immediately after work is completed. Each and every Contractor shall be responsible to re-install the Safety Cable System in accordance to OSHA standards.

11.5 Fall protection will be enforced for Structural Steel Erectors.

1. As for a Contractor engaged in structural steel erection, the Contractor is specifically advised that structural steel erectors shall comply with all protection requirements for all work at a height of six feet (6') or greater above the next lower level, 100 percent of the time, by any of the following means.

   a. Standard guardrail system.

   b. Personal Fall Arrest System (PFAS) – full body harness with shock absorbing lanyard. Maximum free fall distance permitted, with lanyard and lanyard attachment <u>shall not exceed six feet</u> <u>(6').</u> Anchor point must be capable of supporting five thousand pounds. Perimeter guard cables or alignment cables may not be used for anchor points.

   c. Access to work area shall be provided by ladders. There shall be sufficient number of ladders available to reduce the amount of "beam walking." When it is absolutely necessary to traverse a beam, 100% fall protection must be utilized.

   d. Steel erection Contractors must, at all times, <u>be able to certify in writing that each of his employees has been properly trained in both OSHA fall protection standards and the Contractor's site specific project fall protection procedures.</u>

e. Prior to the erection of the steel, the Contractor shall meet with the Project Manager and Safety Representatives to review and document site specific procedures.

END OF SECTION

Certification of Training Documents to be Submitted with Safety Policy/Program

Provide a certification of training for employees on your safety program.

In addition, Contractor shall provide certification of training on the following programs, as they pertain to your contract and project tasks. Certification of training must include: Employee's name, date of training, person conducting the training, topics covered, and a statement that the student has successfully completed the course. This list is not meant to be all inclusive: please refer to OSHA regulations for applicable safety requirements.

a. ☐ Scaffold: 1926.454

b. ☐ Fall Protection 1926.503

c. ☐ Crane Operator: 1926.1427

d. ☐ Signal person (this is for any persons connecting material or equipment for lifting): 1926.1428

e. ☐ Crane maintenance: 1926.1429

f. ☐ Steel erection fall protection: 1926.761

g. ☐ Respiratory protection (medical clearance and training records complying with 1910.134

h. ☐ Powder-actuated tools: 1926.302

i. ☐ Motor Vehicles (are those vehicles that operate within an off-highway jobsite, not open to public traffic): 1926.21

SECTION 014500 - QUALITY CONTROL

1. DESCRIPTION

1.1 Quality control services include inspections and tests performed by independent agencies and governing authorities, as well as by the Contractor. Inspection and testing services are intended to determine compliance of the work with requirements specified. Specific quality control requirements are specified in individual specification sections.

2. RESPONSIBILITIES

2.1 Contractor Responsibilities: Except where indicated as being the Owner's responsibility, quality control services are the Contractor's responsibility, including those specified to be performed by an independent agency and not by the Contractor. The Contractor shall employ and pay an independent agency, testing laboratory or other qualified firm to perform quality control services specified.

1. The Owner will engage and pay for services of an independent agency to perform the inspections and tests that are specified as Owner's responsibilities.

2.2 Retest Responsibility: Where results of inspections or test do not indicate compliance with Contract Documents, retests are the Contractor's responsibility.

2.3 Responsibility for Associated Services: The Contractor shall cooperate with independent agencies performing inspections or test. Provide auxiliary services as are reasonable. Auxiliary services include:

1. Provide access to the Work.

2. Assist taking samples.

3. Deliver samples to test laboratory.

2.4 Coordination: The Contractor and independent test agency shall coordinate the sequence of their activities and shall avoid removing and replacing work to accommodate inspections and test. The Contractor is responsible for scheduling time for inspections and tests.

2.5 Qualifications for Service Agencies: Contractor shall engage only inspection and test service agencies which are pre-qualified as complying with "Recommended Requirements for Independent Laboratory Qualification" by the American Council of Independent Laboratories.

2.6 Submittals: Contractor shall submit a certified written report of each test, Inspection

or similar service, in duplicate to the Construction Manager. Contractor shall submit additional copies of each report to any governing authority, when the authority so directs.

2.7 Report Data: Written inspection or test reports shall include:

1. Name of testing agency or test laboratory.
2. Dates and locations of samples, tests or inspections.
3. Names of individual present.
4. Complete inspection of test data.
5. Test results.
6. Interpretations.
7. Recommendations.

2.8 Repair and Protection: Upon completion of inspection or testing, Contractor shall repair damaged work and restore substrates and finishes. Contractor shall comply with requirements for "Cutting and Patching."

2.9 The 2009 IBC code the following testing is code required:

1. Structural tests and special inspections must be conducted by an approved agency (an agency or firm regularly engaged in conducting tests or furnishing inspection services, approved by the authority having jurisdiction.) This means that contractors will no longer be allowed to cast their own test cylinders for example.
2. Continuous special inspection (the full-time observation of work by an approved special inspector who is present until completion of the work) is required for any steel welds and connections. Critical elements may include: all slip critical bolted connections, complete and partial groove welds, multi-pass fillet welds and single pass fillet welds greater than 5/16".
3. Continuous special inspection is required during the placement of all concrete and shotcrete for the proper application techniques with a few exceptions.
4. Periodic special inspection (the part-time observation by an approved special inspector) is required for any steel welds and connections. Critical elements may include: all slip critical bolted connections, complete and partial groove welds, multi-pass fillet welds and single pass fillet welds greater than 5/16".

5. Spray applied fireproofing requires periodic special inspection for the structural member surface conditions, application, thickness, density and bond strength.

6. Based on the classification, occupancy, and design of the structure, the code requires periodic special inspection for placement of masonry units and reinforcing steel and continuous special inspection of grout placement.

END OF SECTION

SECTION 015113 - TEMPORARY ELECTRICITY

1. GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

1. Electrical Basic Materials and Methods, Division 16 or 26.

1.2 DESCRIPTION OF SYSTEM

1. Power Source Electrical Contractor shall tap in to existing service

1. Suppliers: ***City of Dover***

2. The Electrical Contractor shall provide 277/480 volt, three phase, 60 cycle power service to the site.

3. The Construction Manager will make all arrangements for bringing the power supply to the site and for installation of appropriate temporary transformers to provide for the power supply in 1.2.1.2, above.

4. The source will be adequate to service temporary electrical needs of the proposed construction.

2. Electrical Service

1. Contractor will be responsible to pay for all costs associated with providing electrical service from power source to their respective site office, temporary storage facilities or temporary construction buildings as appropriate.

2. Prior to issuance of the Notice to Proceed for the electrical contract, the Construction Manager will be responsible for providing temporary electrical service as provided in 1.2.2.3, below. After issuance of the Notice to Proceed for the electrical contract, the Electrical Contractor shall become responsible for maintaining all electrical power supply and service facilities installed by the Construction Manager. The Electrical Contractor shall also, from that date forward, be responsible for providing and maintaining temporary electrical service to the site as provided in 1.2.2.3, below.

3. The Construction Manager or Electrical Contractor, as provided in 1.2.2.2 above, shall install temporary electric service for items below, throughout the construction period, such that power can be secured at any desired point with no more than a 60 foot extension:

1. Power Centers for miscellaneous tools and equipment used in the

construction work shall be provided with a minimum of four 20-amp, 120 volt grounding type outlets. Each outlet shall be provided with ground fault detecting circuit breaker protection.

2. Adequate lighting for safe working conditions shall be provided and maintained on a 24 hour per day basis throughout the building, tunnels, and stairways per OSHA requirements. Each lamp must be rated at least 100 watts. Voltage of each socket must be at least 110 volts.

3. Power for testing and checking equipment must be supplied.

3. Capacity

1. All electrical power supply and service lines installed shall be of adequate capacity for construction use by all trades during the construction period at the locations necessary.

2. The Electrical Contractor shall notify the Power Company if unusually heavy loads, such as welding units, are anticipated.

4. Power Costs

1. The Construction Manager will pay all costs of temporary electrical power used during construction.

2. The Owner will pay all costs of power used in the permanent wiring.

1.3 REQUIREMENTS AND REGULATORY AGENCIES

1. The Electrical Contractor will obtain permits as required by local governmental authorities.

2. The temporary electrical service shall comply with National Electrical Code, 1990 Edition and applicable local codes and utility regulations.

1.4 USE OF PERMANENT SYSTEM

1. The Electrical Contractor shall regulate any part of the permanent electrical system which is used for construction purposes to prevent interference with safety and orderly progress of the Work.

2. Contractors shall leave permanent electrical services in a condition as good as new and clean.

2. PRODUCTS

2.1 MATERIALS

1. General

    1. The materials may be new or used, but must be adequate in capacity for the purposes intended and must not create unsafe conditions or violate the requirements of applicable codes.

2. Conductors

    1. Use wire, cable, or busses of appropriate type, sized in accordance with the National Electrical Code for the applied loads.

    2. Use only UL labeled wire and devices.

2.2 EQUIPMENT

1. Provide appropriate enclosure for the environment in which used in compliance with NEMA standards.

3. EXECUTION

3.1 GENERAL

1. Install all work with a neat and orderly appearance.

2. Make structurally sound throughout.

3. Maintain to give continuous service and to provide safe working conditions.

4. Modify temporary power and light installation as job progress requires.

3.2 INSTALLATION

1. Locate so that interference with storage areas, traffic areas and work under other Contracts is avoided.

3.3 REMOVAL

1. Remove all temporary equipment and materials completely upon completion of construction.

2. Repair all damage caused by the installation and restore to satisfactory condition.

END OF SECTION

SECTION 015123 - TEMPORARY HEATING, COOLING AND VENTILATING

1. GENERAL

1.1 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

1. Temporary Electric: Section 015113

2. Temporary Facilities: Section 015200

3. Heating Requirements for Cold Weather Installation and Protection of Materials: Respective specification section for each item of work.

1.2 DEFINITIONS

1. Temporary Enclosures: Sufficient preliminary enclosures of an area of structure, or of an entire building, to prevent entrance or infiltration of rain water, wind or other elements and which will prevent undue heat loss from within enclosed area.

2. Permanent Enclosure: Stage of construction at which all moisture and weather protection elements of construction have been installed in accordance with Contract Documents, either for a portion of structure, or for an entire building.

1.3 DESCRIPTION OF SYSTEM

1. Prior to the building or portion of building being permanently enclosed, the contractor shall provide temporary heat and ventilation and weather protection necessary for his work, as described below. After permanent enclosure, the Construction Manager will provide temporary heat and ventilation in enclosed areas required to:

1. Facilitate progress of Work.

2. Protect Work and products against dampness and cold.

3. Prevent moisture condensation on surfaces.

4. Provide suitable ambient temperatures and humidity levels for installation and curing of materials.

5. Provide adequate ventilation to meet health regulations for safe working environment.

2. Temperatures Required

1. Generally, 24 hours a day: Minimum of 40 degrees F.

2. 24 hours a day during placing, setting and curing of cementitious materials: As required by specification section for each product.

3. 24 hours a day, seven days prior to, and during, placing of interior finishes: woodwork, resilient floors, painting and finishing: As required by specification section for each product.

4. 24 hours a day after application of finishes, and until Substantial Completion: Minimum of 50 degrees F.

3. Ventilation Required:

1. Contractors shall prevent hazardous accumulations of dusts, fumes, mists, vapors or gases in areas occupied during construction.

1. Provide local exhaust ventilation to prevent harmful dispersal of hazardous substances into atmosphere of occupied areas.

2. Dispose of exhaust materials in manner that will not result in harmful dispersal of hazardous substances into atmosphere of occupied areas.

3. Continuously ventilate storage spaces containing hazardous or volatile materials.

2. Contractors shall provide adequate ventilation for:

1. Curing installed materials.

2. Dispersal of humidity.

3. Temporary sanitary facilities.

3. Duration of Operations:

1. For Personnel:

1. At all times personnel occupy an area subject to hazardous accumulations of harmful elements.

2. Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful elements.

2. For curing installed materials: As required by specification section for respective materials.

3. For humidity dispersal: Continuously ventilate to provide suitable ambient conditions for work.

4. The Construction Manager shall maintain strict supervision of operation of temporary heating and ventilating equipment in order to:

    1. Enforce conformance with applicable codes and standards.

    2. Enforce safe practices.

    3. Prevent abuse of services.

1.4 COSTS OF INSTALLATION AND OPERATION

1. The Contractor shall be responsible for all installation and operating costs for any heat and ventilation as required in this section until the permanent HVAC system is in operation.

2. After the permanent HVAC system is operational, the Owner will pay the costs of fuel for temporary heat and ventilation. The Contractor will pay the costs for maintaining the system until final acceptance by the Owner.

3. The Contractor shall be responsible for all installation and operating costs for any heat required to supplement that which is to be supplied by the Construction Manager in 1.3, above.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

1. The Construction Manager will obtain and pay for permits as required by governing authorities for those activities required by this Section.

2. Contractor shall comply with Federal, State and local codes, and utility company regulations.

2. PRODUCTS

2.1 MATERIALS

1. General

    1. Materials may be new or used, but must be adequate for purposes intended and must not create unsafe conditions nor violate requirements of applicable

codes.

2.2 EQUIPMENT

1. Standard products, meeting code requirements.

2. Provide required facilities, including piping, wiring and controls.

3. Portable Heater: Standard Units, meeting code requirements.

    1. Safety Controls against explosion, overheating, and carbon monoxide build up.

    2. Vent direct-fired units to outside.

    3. Provide adequate combustion air.

4. Oil-Fired heaters will not be allowed.

3. EXECUTION

3.1 GENERAL

1. Comply with applicable sections of Division 15 - Mechanical.

2. Install work in neat and orderly manner.

3. Make structurally, mechanically and electrically sound throughout.

4. Maintain to give safe, continuous service at required times and to provide safe working conditions.

5. Modify and extend system as work progress requires.

3.2 INSTALLATION

1. Locate units to provide equitable distribution of heat and air movements.

2. Locate to avoid interference with, or hazards to:

    1. Work or movement of personnel.

    2. Traffic areas.

    3. Materials handling.

4. Storage areas.

5. Work of other Contractors.

6. Finishes.

3.3 OPERATION OF PERMANENT EQUIPMENT

1. The Construction Manager will coordinate with Contractor.

2. The Contractor will place permanent HVAC system in operation only upon written authorization by the Construction Manager.

3. Before operating the permanent HVAC equipment, the Contractor shall confirm to the Construction Manager that:

    1. Inspection has been made by proper authorities.

    2. Systems, equipment piping, strainers, filters and associated operating items are sufficiently complete, cleaned, and ready for operation.

    3. Controls and safety devices are complete and tested, or adequate temporary controls are provided.

    4. Before operating the permanent HVAC equipment, the Contractor shall install temporary filters:

        1. For air handling units.

        2. For permanent ducts.

3.4 REMOVAL

1. The Contractor shall completely remove temporary materials and equipment when no longer required, or on completion of construction.

2. The Contractor shall clean and repair damage caused by temporary installation, and restore equipment to specified or original condition.

3. The Contractor shall remove temporary filters and install new filters, or clean permanent filters, in the permanent HVAC system prior to final acceptance by the Owner.

END OF SECTION

SECTION 015200 - CONSTRUCTION FACILITIES & TEMPORARY CONTROLS

1. GENERAL

1.1 DESCRIPTION

1. Construction Manager and Contractors shall provide all temporary facilities throughout the construction period unless otherwise indicated in the Contract Documents.

2. Construction Manager and Contractors shall pay all costs for providing, maintaining and removing of all temporary facilities unless otherwise indicated in the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

1. Temporary Electric: Section 015113.

2. FACILITIES

2.1 TEMPORARY SANITATION FACILITIES

1. Construction Manager will provide and maintain sanitary facilities for all personnel on the project.

2. The number of sanitary facilities required shall be based on the total number or workers employed on the site and shall be in accordance with the provisions of the applicable code.

3. Construction Manager will maintain sanitary facilities in a sanitary and clean condition at all times.

2.2 TEMPORARY WATER

1. Drinking Water: Contractor shall provide potable water for drinking purposes for all his personnel on the site. He shall furnish disposable drinking cups at water stations. Each water station shall be equipped with a suitable trash container for disposal of the drinking cups.

2. Construction Water: Construction Manager will provide and maintain tap locations for construction water of sufficiently pure and potable quality to avoid deleterious effect on any materials used. Location of construction water tap locations will be determined by the Construction Manager depending on the stage of construction of the incoming water service. Contractor shall provide and maintain all hoses, piping and valves as required for obtaining construction

water from taps provided by the Construction Manager.

2.3 TEMPORARY TELEPHONES

1. Construction Manager will not provide any telephones or fax machines for Contractor's personnel. Each Contractor is responsible for its own phones and fax machines.

2.4 FIELD OFFICE

1. During the period of the Work and until final acceptance of the project, the Construction Manager will provide a weatherproof building for the Construction Manager's Field Project Manager(s) and Superintendent(s). Contractor shall make provisions for its own field office, subject to approval by the Construction Manager.

2.5 FIRE PROTECTION

1. The Carpentry & General Works Contractor will provide and maintain portable fire extinguishers on each floor level and building area. Number to conform to applicable codes.

2. Contractor shall provide additional fire extinguishers as required by OSHA regulations for its work.

3. Fire extinguishers shall be 10lb, Multi-Purpose (ABC) dry chemical, UL labeled, with a rating of 3a:40bc.

2.6 ACCESS ROADS AND PARKING AREAS

1. The Sitework Contractor will provide stabilized entrance road on the site.

2. Neither the Construction Manager nor the Owner will provide parking for Contractor's personnel on or about the project site. All parking provisions required for Contractors will be solely the responsibility of the Contractors or their personnel.

2.7 STORAGE AREAS

1. The Construction Manager will assign storage areas on the site. Storage areas are extremely limited and will be assigned in a manner which will best facilitate the work.

2. Contractor shall provide all other storage space required for its work at off-site locations.

3. All combustible or flammable materials must be safely stored in a secured area in strict accordance with regulations, codes and laws enforced by local, State or Federal agencies, whichsoever is the most stringent.

2.8 FIRST AID STATION

1. The Construction Manager will provide and maintain an unmanned first aid station for all personnel in his jobsite office.

2.9 SECURITY

1. The Construction Manager will provide the following security measures at the site: Security lighting will be provided. No guards will be provided.

2. All other safety and security measures shall be the responsibility of each Contractor. These measures shall include but are not limited to the provision of secured storage for tools, construction equipment, and materials and equipment scheduled for installation in the building.

2.10 BENCH MARKS AND BASELINE

1. The Construction Manager will lay out and establish and maintain bench marks and baselines.

2. The Contractor shall lay out his own work and shall be responsible for the accuracy of same.

3. Contractor shall check grades, lines, levels and dimensions as shown on the drawings and shall promptly report errors or inconsistencies in same to the Construction Manager before Work proceeds.

4. The Contractor is responsible for damaging or altering the bench marks and baselines established by the Construction Manager and shall bear the costs of replacing same.

2.11 FIELD OFFICE AND STORAGE TRAILERS

1. Contractor shall provide and maintain its own field office and storage trailers as required.

2. Contractor shall provide temporary heat and power for its field office and storage trailer.

3. Contractor's field offices and storage trailers shall be located as directed by the

Construction Manager.

2.12 PROJECT SIGN

1. The Construction Manager will provide a Project Sign naming the major participants, as determined by the Owner.

2.13 TRASH DISPOSAL

1. Each Contractor shall be responsible for cleanup and depositing its common trash in the dumpsters provided by the Construction Manager. All debris must be separated as indicated for proper recycling.

2. The Construction Manager will not provide a trash chute.

3. The Construction Manager will provide dumpsters, and will arrange for disposal of common, non-hazardous, work-related trash deposited in these dumpsters.

4. During Demolition, the Selective Demolition, Mechanical & Plumbing and Electrical Contractors will provide their own dumpsters on site.

2.14 HOISTING

1. Contractor shall provide its own materials hoists and cranes. No personnel hoist will be provided.

2.15 SCAFFOLDING AND WORKING PLATFORMS

1. No scaffolding shall be provided by the Construction Manager. Each Contractor shall provide all scaffolding required to perform its Work.

2.16 SAFETY BARRICADES AND RAILINGS

1. The Structural Contractor shall provide barricades around elevator, stair, shaft and cut openings in floors and roofs, and edges of floors and roofs. All barricades shall at a minimum, be constructed of two runs of 1/2" diameter wire rope cable with adequate turn-buckle and eyes such that no more than 60' of cable need be loosened or removed at any given location for access. All cables shall be installed such that no more than 3" of deflection of the cable is achieved at any point between supports. The methods and materials used in barricading shall be in accordance with OSHA and local code regulations, and shall be approved by the Construction Manager prior to installation. Barricades will be installed immediately after the installation of the floor slab on any level or part of a level on the Building. Until a level has been fully barricaded, the Structural Contractor will be responsible for maintenance of the barricades. After a level

has been fully barricaded, the Construction Manager will assume maintenance of the barricades until a subsequent contractor requires the barricades to be removed in order to accomplish his work, at which time that contractor will assume maintenance of the barricades.

2. After the barricades are no longer needed, the Construction Manager will remove the barricades from the site. The Construction Manager will determine the location and scheduling of barriers to be removed.

3. Contractor shall provide for its own barricades at all other trenches, excavations, and locations not specifically identified in Paragraph 1 above.

4. Contractors who remove barricades shall be responsible for replacing them. If, after proper notification, in writing, from the Construction Manager the responsible Contractor does not correct his deficiencies in safety barricade placement, the Construction Manager reserves the right to undertake this work and backcharge the responsible Contractor(s).

5. During the execution of his work, Contractor will provide daily maintenance of, and upon completion of same, restore all barricades in a manner acceptable to prevailing safety standards enforced by local, State or Federal ordinance, whichsoever is most stringent. The intent is to leave no floor penetration or perimeter opening in an unsafe condition.

6. The Construction Manager shall arrange for temporary ladders required for access to each of the floor levels after the completion of floor slab work, and until the final stairs are ready for use.

2.17 PUMPING AND DRAINAGE

1. Contractor shall provide its own pumping and drainage.

2. When an area is released by one Contractor to another, the Contractor releasing an area shall be responsible for leaving it in a drained condition. The incoming Contractor shall assume responsibility for drainage on the day that he is scheduled to start work in the area. If the incoming Contractor is late in starting work, he shall assume responsibility for pumping and drainage arising as a result.

2.18 TEMPORARY BUILDING ENCLOSURES

1. The Carpentry & General Works Contractor will equip all temporary exterior doors of the building with self-closing hardware and padlocks.

2. All other temporary enclosures and protection shall be provided by the

Contractor requiring the protection.

3. Temporary enclosures required due to late delivery of materials or untimely installation of work shall be the responsibility of the Contractor responsible for the delay.

2.19 TEMPORARY POWER AND LIGHTING

1. Contractor shall provide all extension cords and outlets as required for obtaining electric power from power centers provided by the Electrical Contractor. Refer to Section 015113 - TEMPORARY ELECTRIC.

2. Contractor shall provide its own additional temporary lighting of sufficient lighting levels to properly install his work.

2.20 TEMPORARY HEAT

1. Contractor shall provide temporary heat as required for its operations. Once a building has reached the "Permanent Enclosure" stage, temporary heat will be provided as specified in Section 015123 - TEMPORARY HEAT AND VENTILATION.

2. Equipment and methods of temporary heating shall be satisfactory to the Construction Manager.

2.21 PROTECTION OF ADJACENT MATERIALS

1. Contractor shall protect adjacent materials and finishes from damage as a result of its work.

2.22 CLEAN UP

1. Contractor shall arrange for clean up and removal of debris resulting from its operations, and shall dispose of debris in accordance with the provisions of Paragraph 2.13 above. Clean up shall be scheduled on a continual basis to ensure that building, grounds and public properties are maintained free from accumulations of waste materials and trash, but in any case not less than once a week.

2. The Contractor will ensure that all waste materials that are combustible or flammable will be removed from the building at the end of each work day. All trash considered to be edible by rodent will be disposed of in metal containers and removed by the end of the work day.

3. At completion of its Work, each Contractor shall remove waste materials,

rubbish, tools, equipment, and clean up all exposed surfaces in preparation for final cleaning.

4. If, after notification in writing from the Construction Manager, the Contractor does not correct its deficiencies in housekeeping within twenty four (24) hours, the Construction Manager reserves the right to undertake the Work and to backcharge the Contractor.

5. Final clean up prior to Owner occupancy shall be arranged for by the Construction Manager.

2.23 DUST PROTECTION

1. Contractor shall erect and maintain dust proof protection whenever its operations will produce dust and dirt that might filter through the building into occupied or finished areas. Contractor shall be responsible for all cleaning required due to its failure to provide such dust protection.

2.24 PROTECTION OF EXISTING CONSTRUCTION

1. Contractor shall be responsible for all damage that it may cause to materials and equipment stored or installed by other Contractors.

2.25 OTHER

1. Contractor shall provide any other Temporary Facilities and services that it requires and which are not specifically identified above.

3. PERMITS

3.1 The Construction Manager will obtain the Building Permit. All other permits are to be obtained and paid for by the Contractor requiring them.

4. EXECUTION

4.1 GENERAL

1. Contractor shall install all temporary facilities in accordance with applicable codes.

2. Contractor shall maintain temporary facilities for which it is responsible throughout the construction period.

3. Contractor shall remove all temporary facilities for which it is responsible when they are no longer required or when the Construction Manager directs the

removal of same.

4. Contractor shall repair all damage to the Project Site caused by the installation of its temporary facilities.

END OF SECTION

SECTION 016200 - MATERIAL AND EQUIPMENT

1. GENERAL CONDITIONS

1.1 The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate apply to the Work specified in this Section.

1.2 Where work is to be executed under Separate Prime Contracts, the provisions of this Section apply to each Contract.

2. REQUIREMENTS INCLUDED

2.1 All materials and equipment incorporated into the Work shall:

1. be new;

2. conform to applicable specifications and standards; and

3. comply with size, make, type and quality specified, or as specifically approved in writing by the Architect.

2.2 Manufactured and Fabricated Products shall conform to the following requirements:

1. Designed, fabricated and assembled in accord with the best engineering and shop practices.

2. Manufactured like parts of duplicate units to standard sizes and gauges, to be interchangeable.

3. Two or more items of the same kind shall be identical, by the same manufacturer.

4. Products shall be suitable for service conditions.

5. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.

2.3 Contractor shall not use materials or equipment for any purpose other than that for which it is designated or is specified.

2.4 Materials removed form existing structures shall not be reused in the completed work unless specifically indicated or specified.

2.5 For materials and equipment specifically indicated or specified to be reused in the Work:

1. Contractor shall use special care on removal, handling storage and reinstallation, to assure proper function in the completed Work.

2. Arrange for transportation, storage and handling of products which require off-site storage, restoration or renovation. Pay all costs for such work.

3. MANUFACTURER'S INSTRUCTIONS

3.1 When Contract Documents require that installation of work shall comply with manufacturer's printed instructions, Contractor shall obtain and distribute copies of such instructions to parties involved in the installation, including two copies to Construction Manager.

1. Maintain one set of complete instructions at the job site during installation and until completion.

3.2 Contractor shall handle, install, connect, clean, condition and adjust products in strict accord with such instructions and in conformity with specified requirements.

1. Should job conditions or specified requirements conflict with manufacturer's instructions, Contractor shall consult with Construction Manager for further instructions.

2. Contractor shall perform work in accord with manufacturer's instructions. Contractor shall not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

4. TRANSPORTATION AND HANDLING

4.1 Contractor shall arrange deliveries of Products in accord with construction schedules, coordinate to avoid conflict with work and conditions at the site.

1. Deliver Products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.

2. Contractor shall immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals, and that Products are properly protected and undamaged.

4.2 Contractor shall provide equipment and personnel to handle Products by methods to prevent soiling or damage to Products or packaging.

5. STORAGE AND PROTECTION

5.1 Contractor shall store Products in accord with manufacturer's instructions, with seals and labels intact and legible.

1. Contractor shall store Products subject to damage by the elements in weathertight enclosures.

2. Contractor shall maintain temperature and humidity within the ranges required by manufacture's instructions.

5.2 Exterior Storage

1. Contractor shall store fabricated Products above the ground, on blocking or skids, to prevent soiling or staining. Cover Products which are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.

2. Contractor shall store loose granular materials in a well-drained area on soiled surfaces to prevent mixing with foreign matter.

5.3 Contractor shall arrange storage in a manner to provide easy access for inspection. Contractor shall make periodic inspections of stored Products to assure that Products are maintained under specified conditions, and free from damage or deterioration.

5.4 Contractor shall store flammable materials so as to prevent contact with flames and fire. Conform with manufacturer's recommendations and local laws. Pay particular attention to storage of:

1. Roof insulation.

2. Roofing materials, including solvents.

3. Paint materials.

4. Cleaning and other solvents.

5. Fuels.

5.5 Protection after Installation:

1. Contractor shall provide substantial coverings as necessary to protect installed Products from damage from traffic and subsequent construction operations. Remove when no longer needed.

6. <u>SUBSTITUTIONS AND PRODUCT OPTIONS</u>

6.1 Product List.

1. Within 30 days after Contract Date, Contractor shall submit to Construction Manager a complete list of major products proposed to be used, with the name of the manufacturer and the installing Contractor.

6.2 Contractor's Options.

1. For Products specified only by reference standard, Contractor shall select any Product meeting that standard.

2. For Products specified by naming several Products or manufacturers, Contractor shall select any one of the Products or manufacturers named which complies with the specifications.

3. For Products specified by naming one or more Products or manufacturers and "or equal", Bidders must, during the bidding period, submit a request for substitutions for any Product or manufacturer not specifically named. See provisions in Paragraph 1.6.3.

4. For Products specified by naming only one Product and manufacturer, there is no option; and Contractor shall provide the precise Product specified.

6.3 Substitutions.

1. Until a date no later than seven (7) days before the date Bids are due, Architect will consider written requests from bidders for substitution of Products. **The contractor will submit any substitution requests to the Construction Manager for transmittal to the Architect. The** architect will review requests and will notify Bidders in an Addendum if the requested substitution is acceptable.

2. Should the Bidder desire a substitution, it shall submit a separate request for each Product, supported with complete data, with drawings and samples as appropriate, including:

    1. Comparison of the qualities of the proposed substitution with that specified.

    2. Changes required in other elements of the Work because of the substitution.

    3. Effect on the construction schedule.

    4. Cost data comparing the proposed substitution with the Product specified.

    5. Any required license fees or royalties.

6. Availability of maintenance service, and source of replacement materials.

3. Architect, in its sole discretion, shall be the judge of the acceptability of the proposed substitution.

4. A request for a substitution constitutes a representation that Bidder:

    1. has investigated the proposed Product and determined that it is equal to or superior in all respects to that specified;

    2. will provide the same warranties or bonds for the substitution as for the Product specified;

    3. will coordinate the installation of an accepted substitution into the Work, and make such other changes as may be required to make the Work complete in all respects; and

    4. waives all claims for additional costs, under his responsibility, which may subsequently become apparent.

6.4 Architect will review requests for substitutions with reasonable promptness, and notify Bidders, in writing, through the Construction Manager, of the decision to accept or reject the requested substitution. Any decision to accept a substitution must be confirmed in an Addendum issued during the bidding period in order to be valid. Oral approvals will not be binding.

END OF SECTION

SECTION 017123 - FIELD ENGINEERING

1. GENERAL PROVISIONS

1.1 The general provisions of the Contract, including the Conditions of the Contract, (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

1.2 The provisions of the section apply to all contracts.

2. SURVEY

2.1 A site survey will not be prepared. All information has been included in this Bid Pac.

3. CONSTRUCTION MANAGER

3.1 The Construction Manager will establish a bench mark and base line from which structures and grades shall be laid out by Contractors as designated in this section. The total extent of this layout is shown on the site drawings. One bench elevation shall be provided.

END OF SECTION

SECTION 017329 - CUTTING AND PATCHING

1. GENERAL

1.1 Definition: "Cutting and Patching" includes cutting into existing construction to provide for the installation or performance of other work and subsequent fitting and patching required to restore surfaces to their original condition.

1.2 Refer to Other Sections of these specifications for specific cutting and patching requirements and limitations applicable to individual units of work.

1.3 Structural Work: Do not cut and patch structural work in a manner resulting in a reduction of load carrying capacity or load deflection ratio. Submit proposal and request and obtain Architect's/Engineer's approval before proceeding with cut and patch of structural work.

1.4 Operational/Safety Limitations: Do not cut and patch operational elements and safety components in a manner resulting in decreased performance, shortened useful life, or increased maintenance. Submit proposals and requests and obtain Architect's/Engineer's approval before proceeding with cut and patches of structural work.

1.5 Visual/Quality Limitations: Do not cut and patch work exposed to view (exterior and interior) in manner resulting in noticeable reduction of aesthetic qualities and similar qualities, as judged by Architect/Engineer.

1. Engage the original Installer/Fabricator, or (if not available) an acceptable equivalent entity, to cut and patch the following categories of exposed work but not limited to
2. Exterior wall materials, ie., curtain wall
3. Finish floor materials, ie., substrate, carpet, ceramic tile
4. Walls
5. Ceilings

1.6 Limitation on Approvals: Architect's/Engineer's approval to proceed with cutting and patching does not waive right to later acquire removal/replacement of work found to be cut and patched in an unsatisfactory manner, as judged by Architect/Engineer.

2. MATERIALS

2.1 General: Use materials for cutting and patching that are identical to existing materials. If identical materials are not available, or cannot be used, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials for cutting and patching that will result in equal or better

performance characteristics.

3. EXECUTION

3.1 Inspection: Before cutting, examine surfaces to be cut and patched and conditions under which the work is to be performed. If unsafe or otherwise unsatisfactory conditions are encountered, take corrective action before proceeding with the work.

3.2 Temporary Support: To prevent failure provide temporary support of work to be cut.

3.3 Protection: Protect other work during cutting and patching to prevent damage. Provide protection from adverse weather conditions for that part of the project that may be exposed during cutting and patching operations.

1. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

2. Take precautions not to cut existing pipe, conduit or duct serving the building but scheduled to be relocated until provisions have been made to bypass them.

3.4 Cutting: Cut the work using methods that are least likely to damage work to be retained or adjoining work. Where possible review proposed procedures with the original installer; comply with original installer's recommendations.

1. Where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut through concrete and masonry using a cutting machine such as a carborundum saw or core drill. Cut holes and slots neatly to size required with minimum disturbance of adjacent work. To avoid marring existing finished surfaces, cut and drill from the exposed or finished side into concealed surfaces. Temporarily cover openings when not in use.

3.5 Patching: Patch with seams which are durable and as invisible as possible. Comply with specified tolerances for the work.

1. Restore exposed finishes of patched areas and where necessary extend finish restoration into retained adjoining work in a manner which will eliminate evidence of patching and finishing.

END OF SECTION

SECTION 017700 – CONTRACT CLOSEOUT

1. DESCRIPTION OF REQUIREMENTS

1.1 Provisions of this section apply to the procedural requirements for the actual close out of the Work, not to the administrative matters such as final payment or the change over of insurance. Close out requirements relate to both substantial and final completion of the Work; they also apply to individual portions of completed work as well as the Total work. Specific requirements contained in other sections have precedence over the general requirements contained in this section.

2. PROCEDURES AT SUBSTANTIAL COMPLETION

2.1 Prerequisites: Contractor shall comply with the General Conditions and complete the following before requesting inspection of the Work, or a designated portion of the Work, for certification of substantial completion:

1. submit executed warranties, workmanship bonds, maintenance agreements, inspection certificates, releases of liens, tax certification and similar required documentation for specific units of work, and documents needed to enable Owner's unrestricted occupancy and use;

2. submit record documentation, maintenance manuals, tools, spare parts, keys and similar operational items;

3. complete instructions of Owner's operating personnel, and start up of systems; and

4. complete final cleaning and remove temporary facilities and tools.

2.2 Inspection Procedures: Upon receipt of Contractor's request, Architect/Engineer will either proceed with inspection or advise Construction Manger of prerequisites not fulfilled. Following initial inspection, Architect/Engineer will either prepare certificate of substantial completion, or advise Construction Manager of work which must be performed prior to issuance of certificate. The Architect/Engineer will repeat the inspection when requested and assure that the work has been substantially completed. Results of the completed inspection will form the initial "punch list" for final acceptance.

2.3 Punch List Procedures: Each Contractor shall be given a copy of the punch list with its appropriate work identified. Each Contractor shall be given 9 (nine) calendar work days to complete their punch list work. On the 10th day or as determined by the Construction Manager the Construction Manager shall employ other Contractors, as required, to complete any incomplete punch list work and retain from the appropriate Contractors retainage all costs incurred.

3. PROCEDURES AT FINAL ACCEPTANCE

3.1 Reinspection Procedure: The Architect/Engineer will reinspect the Work upon receipt of the Contractor's notice that, except for those items whose completion has been delayed due to circumstances that are acceptable to the Architect/Engineer, the Work has been completed, including punch list items from earlier inspections. Upon completion of reinspection, the Architect/Engineer will either recommend final acceptance and final payment, or will advise the Contractor of work not completed or obligations not fulfilled as required for final acceptance. If necessary, this procedure will be repeated.

4. RECORD DOCUMENTATION

4.1 Record Drawings: Contractor shall maintain a complete set of either blue or black line prints of the contract documents and shop drawings for record mark up purposes throughout the Contract Time. Contractor shall mark up these drawings during the course of the Work to show both changes and the actual installation, in sufficient detail to form a complete record for Owner's purposes giving particular attention to work that will be concealed and difficult to measure and record at a later date, and Work which may require servicing or replacement during the life of the project. Require the entities marking prints to sign and date each mark up. Bind prints into manageable sets, with durable paper cover, appropriately labeled.

4.2 Maintenance Manual: Contractor shall provide 3-ring vinyl covered binders containing required maintenance manuals, properly identified and indexed and including operating and maintenance instructions extended to cover emergencies, spare parts, warranties, inspection procedures, diagrams, safety, security, and similar appropriate data for each system of equipment item.

4.3 State Tax Certification: Contractor shall provide recent Delaware State Tax Certification form as issued by State of Delaware, Department of Finance, Division of Revenue, Carvel State Office Building, 820 N. French Street, Wilmington, Delaware 19801.

5. GENERAL CLOSE OUT REQUIREMENTS

5.1 Operator Instruction: Contractor shall require each Installer of systems requiring continued operation and maintenance by Owner's operating personnel, to provide on location instruction to Owner's personnel, sufficient to ensure safe, secure, efficient, non-failing utilization and operation of systems. Contractor shall provide instructions for the following categories of work:

1. Mechanical/electrical/electronic systems (not limited to work of Division 15 and 16).

2. Roofing, flashing, joint sealers.
3. Floor finishes.

6. FINAL CLEANING

6.1 At the time of project close out Contractor shall clean or reclean the Work to the condition expected from a normal, commercial building cleaning and maintenance program. Complete the following cleaning operations before requesting the Architect/Engineer's inspection for certification of substantial completion:

1. Remove non-permanent protections and labels.
2. Polish glass.
3. Clean exposed finishes.
4. Touch up minor finish damage.
5. Clean or replace mechanical systems filters.
6. Remove debris.
7. Broom clean unoccupied spaces.
8. Sanitize plumbing and food service facilities.
9. Clean light fixtures and replace burned out lamps.
10. Sweep and wash paved areas.
11. Police yards and grounds.

END OF SECTION

SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

B. Related Sections:

1. Division 31 Section "Site Clearing" for removing existing trees and shrubs.

1.3 DEFINITIONS

A. Caliper: Diameter of a trunk measured by a diameter tape or the average of the smallest and largest diameters at 6 inches (150 mm) above the ground for trees up to, and including, 4-inch (100-mm) size; and 12 inches (300 mm) above the ground for trees larger than 4-inch (100-mm) size.

B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.

D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of the following:

1. Organic Mulch: 1-pint (0.5-L) volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
2. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.

C. Qualification Data: For qualified arborist and tree service firm.

D. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

E. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

F. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.5 QUALITY ASSURANCE

A. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

B. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:

a. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
b. Enforcing requirements for protection zones.
c. Arborist's responsibilities.
d. Field quality control.

1.6 PROJECT CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch (25 mm) in diameter; and free of weeds, roots, and toxic and other nonsoil materials.

1. Obtain topsoil only from well-drained sites where topsoil is 4 inches (100 mm) deep or more; do not obtain from bogs or marshes.

B. Topsoil: Stockpiled topsoil from location shown on Drawings.

C. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:

1. Type: Shredded hardwood.
2. Size Range: 3 inches (76 mm) maximum, 1/2 inch (13 mm) minimum.
3. Color: Natural.

D. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements.

1. Wood Protection-Zone Fencing: Constructed of two 2-by-4-inch (50-by-100-mm) horizontal rails, with 2-by-2-inch (50-by-50-mm) preservative-treated wood posts spaced not more than 8 feet (2.4 m) apart, and lower rail set halfway between top rail and ground.

   a. Height: 4 feet (1.2 m).

2. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch (50-mm) maximum opening in pattern and weighing a minimum of 0.4 lb/ft. (0.6 kg/m); remaining flexible from minus 60 to plus 200 deg F (minus 16 to plus 93 deg C); inert to most chemicals and acids; minimum tensile yield strength of 2000 psi (13.8 MPa) and ultimate tensile strength of 2680 psi (18.5 MPa); secured with plastic bands or galvanized-steel or stainless-steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 8 feet (2.4 m) apart.

   a. Height: 4 feet (1.2 m).

b. Color: High-visibility orange, nonfading.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

A. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Tie a 1-inch (25-mm) blue-vinyl tape around each tree trunk at 54 inches (1372 mm) above the ground.

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated.

1. Apply 4-inch (100-mm) average thickness of organic mulch. Do not place mulch within 6 inches (150 mm) of tree trunks.

3.3 TREE- AND PLANT-PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones in a manner that will prevent people from easily entering protected area except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

1. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.

B. Maintain protection zones free of weeds and trash.

C. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

D. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.

1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Division 31 Section "Earth Moving."

B. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning.

C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches (75 mm) back from new construction and as required for root pruning.

D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 ROOT PRUNING

A. Prune roots that are affected by temporary and permanent construction. Prune roots as follows:

1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
3. Cover exposed roots with burlap and water regularly.
4. Backfill as soon as possible according to requirements in Division 31 Section "Earth Moving."

3.6 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.

1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.

C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

D. Minor Fill within Protection Zone: Where existing grade is 2 inches (50 mm) or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.7 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.8 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

1. Submit details of proposed root cutting and tree and shrub repairs.
2. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
3. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
4. Perform repairs within 24 hours.
5. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Trees: Remove and replace trees indicated to remain that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size and species as those being replaced for each tree that measures 6 inches (150 mm) or smaller in caliper size.
2. Provide one new tree(s) of 6-inch (150-mm) caliper size for each tree being replaced that measures more than 6 inches (150 mm) in caliper size.

3. Plant and maintain new trees as specified in Division 32 Section "Plants."

C. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 015639

SECTION 018113 - SUSTAINABLE DESIGN REQUIREMENTS - LEED FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements and procedures for compliance with certain USGBC LEED prerequisites and credits needed for Project to be eligible to obtain LEED Silver certification based on USGBC's "LEED 2009 for New Construction & Major Renovations."

1. Other LEED prerequisites and credits needed to obtain LEED certification depend on product selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.

B. Related Requirements:

1. Divisions 01 through 33 Sections for LEED requirements specific to the work of each of these Sections. Requirements may or may not include reference to LEED.

1.3 DEFINITIONS

A. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.

B. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

C. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

1. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
2. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Respond to questions and requests from Architect regarding LEED credits that are the responsibility of the Contractor, that depend on product selection or product qualities. Document responses as informational submittals.

1.5 ACTION SUBMITTALS

A. General: Submit additional LEED submittals required by other Specification Sections.

B. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.

C. LEED Documentation Submittals:

1. Credit EA 5: Product data and wiring diagrams for sensors and data collection system used to provide continuous metering of building energy-consumption performance over time.
2. Credit MR 2: Comply with Division 01 Section "Construction Waste Management and Disposal."
3. Credit MR 3: Receipts for salvaged and refurbished materials used for Project, indicating sources and costs for salvaged and refurbished materials.
4. Credit MR 4: Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating cost for each product having recycled content.
5. Credit MR 5: Product data for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
6. Credit MR 7: Product data and chain-of-custody certificates for products containing certified wood. Include statement indicating cost for each certified wood product.
7. Credit EQ 3.1:

    a. Construction indoor-air-quality management plan.
    b. Product data for temporary filtration media.
    c. Product data for filtration media used during occupancy.

d. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.

8. Credit IEQ 3.2:

a. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
b. Product data for filtration media used during flush-out and during occupancy.
c. Report from testing and inspecting agency indicating results of indoor-air-quality testing and documentation showing compliance with indoor-air-quality testing procedures and requirements.

9. Credit IEQ 4.1: Product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used.
10. Credit IEQ 4.2: Product data for paints and coatings used inside the weatherproofing system indicating VOC content of each product used.
11. Credit IEQ 4.4: Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

1.6 INFORMATIONAL SUBMITTALS

A. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:

1. Furniture.
2. Plumbing.
3. Mechanical.
4. Electrical.
5. Specialty items such as elevators and equipment.
6. Wood-based construction materials.

B. LEED Action Plans: Provide preliminary submittals within 14 days of date established for the Notice to Proceed indicating how the following requirements will be met:

1. Credit MR 2: Waste management plan complying with Division 01 Section "Construction Waste Management and Disposal."
2. Credit MR 3: List of proposed salvaged, refurbished, and reused materials. Identify each material that will be salvaged, refurbished, or reused, including its source, cost, and replacement cost if the item was to be purchased new.
3. Credit MR 4: List of proposed materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.

4. Credit MR 5: List of proposed regional materials. Identify each regional material, including its source, cost, and the fraction by weight that is considered regional.
5. Credit MR 7: List of proposed certified wood products. Indicate each product containing certified wood, including its source and cost of certified wood products.
6. Credit IEQ 3.1: Construction indoor-air-quality management plan.

C. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with LEED action plans for the following:

1. Credit MR 2: Waste reduction progress reports complying with Division 01 Section "Construction Waste Management and Disposal."
2. Credit MR 3: Salvaged, refurbished, and reused materials.
3. Credit MR 4: Recycled content.
4. Credit MR 5: Regional materials.
5. Credit MR 7: Certified wood products.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Provide products and procedures necessary to obtain LEED credits required in this Section. Although other Sections may specify some requirements that contribute to LEED credits, the Contractor shall determine additional materials and procedures necessary to obtain LEED credits indicated.

2.2 SALVAGED, REFURBISHED, OR REUSED MATERIALS

A. Credit MR 3: Not less than 5 percent of building materials (by cost) shall be salvaged, refurbished, or reused materials. The following materials may be salvaged, refurbished, or reused materials:

1. Selected wood doors and hardware.
2. Interior light fixtures.
3. Standing seam metal roof panels.
4. Metal soffit panels.
5. Metal wall panels.

2.3 RECYCLED CONTENT OF MATERIALS

A. Credit MR 4: Building materials shall have recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content for Project constitutes a minimum of 10 percent of cost of materials used for Project.

1. Cost of post-consumer recycled content plus one-half of pre-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content plus one-half of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
2. Do not include plumbing, mechanical and electrical components, and specialty items such as elevators and equipment in the calculation.

2.4 REGIONAL MATERIALS

A. Credit MR 5: Not less than 10 percent of building materials (by cost) shall be regional materials.

2.5 CERTIFIED WOOD

A. Credit MR 7: Not less than 50 percent (by cost) of wood-based materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

1. Wood-based materials include, but are not limited to, the following materials when made from wood, engineered wood products, or wood-based panel products:

   a. Rough carpentry.
   b. Miscellaneous carpentry.
   c. Finish carpentry.
   d. Architectural woodwork.
   e. Furniture.

2.6 LOW-EMITTING MATERIALS

A. Credit IEQ 4.1: For field applications that are inside the weatherproofing system, adhesives and sealants shall comply with the following VOC content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Metal-to-Metal Adhesives: 30 g/L.
3. Adhesives for Porous Materials (Except Wood): 50 g/L.
4. Subfloor Adhesives: 50 g/L.
5. Plastic Foam Adhesives: 50 g/L.
6. Carpet Adhesives: 50 g/L.
7. Carpet Pad Adhesives: 50 g/L.
8. VCT and Asphalt Tile Adhesives: 50 g/L.
9. Cove Base Adhesives: 50 g/L.
10. Gypsum Board and Panel Adhesives: 50 g/L.
11. Rubber Floor Adhesives: 60 g/L.
12. Ceramic Tile Adhesives: 65 g/L.

13. Multipurpose Construction Adhesives: 70 g/L.
14. Fiberglass Adhesives: 80 g/L.
15. Contact Adhesive: 80 g/L.
16. Structural Glazing Adhesives: 100 g/L.
17. Wood Flooring Adhesive: 100 g/L.
18. Structural Wood Member Adhesive: 140 g/L.
19. Single-Ply Roof Membrane Adhesive: 250 g/L.
20. Special-Purpose Contact Adhesive (contact adhesive that is used to bond melamine-covered board, metal, unsupported vinyl, rubber, or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.
21. Top and Trim Adhesive: 250 g/L.
22. Plastic Cement Welding Compounds: 250 g/L.
23. ABS Welding Compounds: 325 g/L.
24. CPVC Welding Compounds: 490 g/L.
25. PVC Welding Compounds: 510 g/L.
26. Adhesive Primer for Plastic: 550 g/L.
27. Sheet-Applied Rubber Lining Adhesive: 850 g/L.
28. Aerosol Adhesive, General-Purpose Mist Spray: 65 percent by weight.
29. Aerosol Adhesive, General-Purpose Web Spray: 55 percent by weight.
30. Special-Purpose Aerosol Adhesive (All Types): 70 percent by weight.
31. Other Adhesives: 250 g/L.
32. Architectural Sealants: 250 g/L.
33. Nonmembrane Roof Sealants: 300 g/L.
34. Single-Ply Roof Membrane Sealants: 450 g/L.
35. Other Sealants: 420 g/L.
36. Sealant Primers for Nonporous Substrates: 250 g/L.
37. Sealant Primers for Porous Substrates: 775 g/L.
38. Modified Bituminous Sealant Primers: 500 g/L.
39. Other Sealant Primers: 750 g/L.

B. Credit IEQ 4.2: For field applications that are inside the weatherproofing system, paints and coatings shall comply with the following VOC content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Flat Paints and Coatings: VOC not more than 50 g/L.
2. Nonflat Paints and Coatings: VOC not more than 150 g/L.
3. Dry-Fog Coatings: VOC not more than 400 g/L.
4. Primers, Sealers, and Undercoaters: VOC not more than 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: VOC not more than 340 g/L.
7. Pretreatment Wash Primers: VOC not more than 420 g/L.
8. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
9. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
10. Floor Coatings: VOC not more than 100 g/L.
11. Shellacs, Clear: VOC not more than 730 g/L.
12. Shellacs, Pigmented: VOC not more than 550 g/L.
13. Stains: VOC not more than 250 g/L.

C. Credit IEQ 4.4: Composite wood, agrifiber products, and adhesives shall not contain urea-formaldehyde resin.

PART 3 - EXECUTION

3.1 REFRIGERANT AND CLEAN-AGENT FIRE-EXTINGUISHING-AGENT REMOVAL

A. Prerequisite EA 3: Remove CFC-based refrigerants from existing HVAC&R equipment indicated to remain and replace with refrigerants that are not CFC based. Replace or adjust existing equipment to accommodate new refrigerant as described in Division 23 Sections.

B. Credit EA 4: Remove clean-agent fire-extinguishing agents that contain HCFCs or halons and replace with agent that does not contain HCFCs or halons. See Division 21 Section "Clean-Agent Fire-Extinguishing Systems" for additional requirements.

3.2 MEASUREMENT AND VERIFICATION

A. Credit EA 5: Implement measurement and verification plan consistent with Option B: Energy Conservation Measure Isolation in the EVO's "International Performance Measurement and Verification Protocol (IPMVP), Volume III: Concepts and Options for Determining Energy Savings in New Construction,"

B. If not already in place, install metering equipment to measure energy usage. Monitor, record, and trend log measurements.

C. Evaluate energy performance and efficiency by comparing actual to predicted performance.

D. Measurement and verification period shall cover at least one year of postconstruction occupancy.

3.3 CONSTRUCTION WASTE MANAGEMENT

A. Credit MR 2: Comply with Division 01 Section "Construction Waste Management and Disposal."

3.4 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

A. Credit IEQ 3.1: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."

1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.

2. Replace all air filters immediately prior to occupancy.

B. Credit IEQ 3.2: Comply with one of the following requirements:

1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. (4 300 000 L) of outdoor air per sq. ft. (sq. m) of floor area while maintaining an internal temperature of at least 60 deg F (16 deg C) and a relative humidity no higher than 60 percent.

2. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. (1 070 000 L) of outdoor air per sq. ft. (sq. m) of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. (1.52 L/s per sq. m) of outside air or the design minimum outside air rate determined in Prerequisite EQ 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14000 cu. ft./sq. ft. (4 300 000 L/sq. m) of outside air has been delivered to the space.

3. Air-Quality Testing:

a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," and as additionally detailed in the USGBC's "Green Building Design and Construction Reference Guide."

b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:

1) Formaldehyde: 27 ppb.
2) Particulates (PM10): 50 micrograms/cu. m.
3) Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
4) 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
5) Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.

c. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting noncomplying building areas, take samples from same locations as in the first test.

d. Air-sample testing shall be conducted as follows:

1) All measurements shall be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
2) Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Nonfixed furnishings

such as workstations and partitions are encouraged, but not required, to be in place for the testing.

3) Number of sampling locations varies depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft. (2300 sq. m) or for each contiguous floor area, whichever is larger, and shall include areas with the least ventilation and greatest presumed source strength.

4) Air samples shall be collected between 3 and 6 feet (0.9 and 1.8 m) from the floor to represent the breathing zone of occupants, and over a minimum four-hour period.

END OF SECTION 018113.13

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
2. Section 017300 "Execution" for cutting and patching procedures.
3. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property , for environmental protection , for dust control and , for noise control. Indicate proposed locations and construction of barriers.

C. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.

D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

E. Predemolition Photographs or Video: Submit before Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

G. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before selective demolition, Owner will remove the following items:

B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PEFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

C. LEED Requirements for Building Reuse:

1. Credit MR 1.1 and Credit MR 1.2: Maintain existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and nonstructural roofing material) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.

1. Comply with requirements specified in Section 013233 "Photographic Documentation."
2. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.
3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."

B. Reuse of Building Elements: Project has been designed to result in end-of-Project rates for reuse of building elements as follows. Do not demolish building elements beyond what is indicated on Drawings without Architect's approval.

1. Building Structure and Shell: 75 percent.
2. Nonshell Elements: 40 percent.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section 074113 "Metal Roof Panels" for new roofing requirements.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.8 SELECTIVE DEMOLITION SCHEDULE

A. Existing Construction to Be Removed:
1. Exterior walls, windows, doors, and roof as indicated on the drawings.
2. Interior partitions, doors, finishes, ceilings, etc., as indicated on the drawings.
3. HVAC, plumbing and electrical systems, as indicated on the drawings.

B. Existing Items to Be Removed and Salvaged:
1. The Owner will remove all items to be Salvaged prior to the start of demolition/construction, and may include, but not limited to the following:

a. Doors and hardware
b. Cabinetry
c. Toilet accessories and/or partitions
d. Motors, electronics, controls, etc.

C. Existing Items to Be Removed and Reinstalled:
1. Selected wood doors.
2. Light fixtures.
3. Brick veneer, salvage existing brick to be reuse to patch and repaid areas of alteration to the existing building.
4. Metal plate wall panels, salvage existing metal plate wall panels to be reuse to patch and repaid areas of alteration to the existing building, is needed.

END OF SECTION 024119

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings.
2. Slabs-on-grade.

B. Related Sections:

1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.
2. Section 321313 "Concrete Paving" for concrete pavement and walks.
3. Section 321316 "Decorative Concrete Paving" for decorative concrete pavement and walks.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Design Mixtures for Credit ID 1.1: For each concrete mixture containing fly ash as a replacement for portland cement or other portland cement replacements, and for equivalent concrete mixtures that do not contain portland cement replacements.

C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer, and testing agency.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Steel reinforcement and accessories.
4. Curing compounds.
5. Floor and slab treatments.
6. Bonding agents.
7. Adhesives.
8. Vapor retarders.
9. Semirigid joint filler.
10. Joint-filler strips.
11. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

F. Field quality-control reports.

G. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete."
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

G. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete subcontractor.
e. Special concrete finish subcontractor.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

D. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 60 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.

B. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I or Type II may be supplemented with the following:

a. Fly Ash: ASTM C 618, Class F.
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches (38 mm) for foundations, 1 inch (25 mm) for piers, 3/4 inch (19 mm) for slabs nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 VAPOR RETARDERS

A. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick.

2.7 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A (non-yellowing).

1. Products: Subject to compliance with requirements, acceptable manufacturers but are not limited to, the following:

   a. BASF Construction Chemicals.
   b. Euclid Chemical Company (The).
   c. L&M Construction Chemicals, Inc
   d. Meadows, W. R., Inc..

2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.8 RELATED MATERIALS

A. Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber for exterior locations and ASTM D 1752, cork or self-expanding cork for interior locations.

B. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types I and II, non-load bearing and Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

D. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

E. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.9 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.10 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Use Fly Ash, Pozzolan, Ground Granulated Blast-Furnace Slag and Silica Fume as needed to reduce the total amount of Portland Cement, which would otherwise be used. By not less than 40 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.50.
3. Slump Limit: 4 inches (100 mm) plus or minus 1 inch (25 mm).
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for exterior concrete.

B. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Minimum Cementitious Materials Content: 470 lb/cu. yd. (279 kg/cu. m).
3. Slump Limit: 4 inches (100 mm) plus or minus 1 inch (25 mm).
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch (19-mm) nominal maximum aggregate size.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.12 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
2. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to

prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration

to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:

a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.

D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.11 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.12 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.13 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

B. Inspections:

1. Steel reinforcement placement.
2. Headed bolts and studs.
3. Verification of use of required design mixture.
4. Concrete placement, including conveying and depositing.
5. Curing procedures and maintenance of curing temperature.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.

5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
    a. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing.

3.14 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 040120 - MAINTENANCE OF UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes maintenance of unit masonry consisting of brick clay masonry restoration and cleaning as follows:

1. Repairing unit masonry, including replacing units.
2. Repointing joints.
3. Preliminary cleaning, including removing plant growth.
4. Cleaning exposed unit masonry surfaces.

B. Related Sections:

1. Division 04 Section "Unit Masonry" for new clay masonry construction.
2. Division 07 Section "Water Repellents" for water repellents applied to clay masonry.
3. Division 07 Section "Sheet Metal Flashing and Trim" for metal flashing installed in or on restored clay masonry.

1.3 DEFINITIONS

A. Very Low-Pressure Spray: Under 100 psi (690 kPa).

B. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s.

C. Medium-Pressure Spray: 400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s.

D. High-Pressure Spray: 800 to 1200 psi (5510 to 8250 kPa); 4 to 6 gpm (0.25 to 0.4 L/s.

E. Saturation Coefficient: Ratio of the weight of water absorbed during immersion in cold water to weight absorbed during immersion in boiling water; used as an indication of resistance of masonry units to freezing and thawing.

1.4 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on masonry units as follows.

1. Provide test specimens as indicated and representative of proposed materials and construction.
2. Existing Brick: Test each type of existing masonry unit indicated for replacement, according to testing methods in ASTM C 67 for compressive strength, 24-hour cold-water absorption, 5-hour boil absorption, saturation coefficient, and initial rate of absorption (suction). Carefully remove five existing units from locations designated by Architect. Take testing samples from these units.
3. Existing Mortar: Test according to ASTM C 295, modified as agreed by testing service and Architect for Project requirements, to determine proportional composition of original ingredients, sizes and colors of aggregates, and approximate strength. Use X-ray diffraction, infrared spectroscopy, and differential thermal analysis as necessary to supplement microscopical methods. Carefully remove existing mortar from within joints at five locations designated by Architect.
4. Temporary Patch: As directed by Architect, provide temporary materials at locations from which existing samples were taken.
5. Replacement Brick: Test each proposed type of replacement masonry unit, according to sampling and testing methods in ASTM C 67 for compressive strength, 24-hour cold-water absorption, 5-hour boil absorption, saturation coefficient, and initial rate of absorption (suction).

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include recommendations for application and use. Include test data substantiating that products comply with requirements.

B. Shop Drawings: For the following:

1. Provisions for expansion joints or other sealant joints.
2. Provisions for flashing, lighting fixtures, conduits, and weep holes as required.
3. Replacement and repair anchors. Include details of anchors within individual masonry units, with locations of anchors and dimensions of holes and recesses in units required for anchors.

C. Samples for Initial Selection: For the following:

1. Pointing Mortar: Submit sets of mortar for pointing in the form of sample mortar strips, 6 inches (150 mm) long by 1/4 inch (6 mm) wide, set in aluminum or plastic channels.

   a. Have each set contain a close color range of at least three Samples of different mixes of colored sands and cements that produce a mortar matching the cleaned masonry when cured and dry.

b. Submit with precise measurements on ingredients, proportions, gradations, and sources of colored sands from which each Sample was made.

2. Patching Compound: Submit sets of patching compound Samples in the form of plugs (patches in drilled holes) in sample units of masonry representative of the range of masonry colors on the building.

a. Have each set contain a close color range of at least three Samples of different mixes of patching compound that matches the variations in existing masonry when cured and dry.

3. Sealant Materials: See Division 07 Section "Joint Sealants."
4. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For the following:

1. Each type of masonry unit to be used for replacing existing units. Include sets of Samples as necessary to show the full range of shape, color, and texture to be expected.

a. For each brick type, provide straps or panels containing at least four bricks. Include multiple straps for brick with a wide range.

2. Each type of sand used for pointing mortar; minimum 1 lb (0.5 kg) of each in plastic screw-top jars.

a. For blended sands, provide Samples of each component and blend.
b. Identify sources, both supplier and quarry, of each type of sand.

3. Each type, color, and texture of pointing mortar in the form of sample mortar strips, 6 inches (150 mm) long by 1/2 inch (13 mm) wide, set in aluminum or plastic channels.

a. Include with each Sample a list of ingredients with proportions of each. Identify sources, both supplier and quarry, of each type of sand and brand names of cementitious materials and pigments if any.

4. Each type of masonry patching compound in the form of briquettes, at least 3 inches (75 mm) long by 1-1/2 inches (38 mm) wide. Document each Sample with manufacturer and stock number or other information necessary to order additional material.
5. Sealant Materials: See Division 07 Section "Joint Sealants."
6. Accessories: Each type of anchor, accessory, and miscellaneous support.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For restoration specialists, including field supervisors and restoration workers.

B. Preconstruction Test Reports: For existing and replacement masonry units.

C. Quality-Control Program.

D. Restoration Program.

E. Cleaning Program.

1.7 QUALITY ASSURANCE

A. Restoration Specialist Qualifications: Engage an experienced masonry restoration and cleaning firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience installing standard unit masonry is not sufficient experience for masonry restoration work.

1. At Contractor's option, work may be divided between two specialist firms: one for cleaning work and one for repair work.
2. Field Supervision: Restoration specialist firms shall maintain experienced full-time supervisors on Project site during times that clay masonry restoration and cleaning work is in progress. Supervisors shall not be changed during Project except for causes beyond the control of restoration specialist firm.
3. Restoration Worker Qualifications: Persons who are experienced in restoration work of types they will be performing. When masonry units are being patched, assign at least one worker among those performing patching work who is trained and certified by manufacturer of patching compound to apply its products.

B. Chemical-Cleaner Manufacturer Qualifications: A firm regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory-trained representatives who are available for consultation and Project-site inspection and assistance at no additional cost.

C. Source Limitations: Obtain each type of material for masonry restoration (face brick, cement, sand, etc.) from one source with resources to provide materials of consistent quality in appearance and physical properties.

D. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising performance and preventing damage due to worker fatigue.

E. Restoration Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for each phase of restoration work including protection of surrounding materials and Project site.

1. Include methods for keeping pointing mortar damp during curing period.
2. If materials and methods other than those indicated are proposed for any phase of restoration work, add to the Quality-Control Program a written description of such materials and methods, including evidence of successful use on comparable projects, and

demonstrations to show their effectiveness for this Project and worker's ability to use such materials and methods properly.

F. Cleaning Program: Prepare a written cleaning program that describes cleaning process in detail, including materials, methods, and equipment to be used, protection of surrounding materials, and control of runoff during operations.

1. If materials and methods other than those indicated are proposed for any phase of restoration work, add to the Quality-Control Program a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project and worker's ability to use such materials and methods properly.

G. Cleaning and Repair Appearance Standard: Cleaned and repaired surfaces are to have a uniform appearance as viewed from 20 feet (6 m) away by Architect. Perform additional paint and stain removal, general cleaning, and spot cleaning of small areas that are noticeably different, so that surface blends smoothly into surrounding areas.

H. Mockups: Prepare mockups of restoration and cleaning to demonstrate aesthetic effects and set quality standards for materials and execution and for fabrication and installation.

1. Masonry Repair: Prepare sample areas for each type of masonry material indicated to have repair work performed. If not otherwise indicated, size each mockup not smaller than 2 adjacent whole units or approximately 48 inches (1200 mm) in least dimension. Erect sample areas in existing walls unless otherwise indicated, to demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:

a. Replacement:

1) Four brick units replaced.

b. Patching: Three small holes at least 1 inch (25 mm) in diameter for each type of masonry material indicated to be patched, so as to leave no evidence of repair.
c. Widening Joints: Widen a joint in 2 separate locations , each approximately 12 inches (300 mm) long.

2. Repointing: Rake out joints in 2 separate areas , each approximately 36 inches (900 mm) high by 48 inches (1200 mm) wide for each type of repointing required and repoint one of the areas.
3. Cleaning: Clean an area approximately 25 sq. ft. (2.3 sq. m) for each type of masonry and surface condition.

a. Test cleaners and methods on samples of adjacent materials for possible adverse reactions. Do not use cleaners and methods known to have deleterious effect.
b. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.

4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

I. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to masonry restoration and cleaning including, but not limited to, the following:

a. Construction schedule. Verify availability of materials, Restoration Specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
b. Materials, material application, sequencing, tolerances, and required clearances.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver masonry units to Project site strapped together in suitable packs or pallets or in heavy-duty cartons.

B. Deliver other materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

D. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.

E. Store lime putty covered with water in sealed containers.

F. Store sand where grading and other required characteristics can be maintained and contamination avoided.

1.9 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit masonry restoration and cleaning work to be performed according to manufacturers' written instructions and specified requirements.

B. Repair masonry units and repoint mortar joints only when air temperature is between 40 and 90 deg F (4 and 32 deg C) and is predicted to remain so for at least 7 days after completion of the Work unless otherwise indicated.

C. Cold-Weather Requirements: Comply with the following procedures for masonry repair and mortar-joint pointing unless otherwise indicated:

1. When air temperature is below 40 deg F (4 deg C), heat mortar ingredients, masonry repair materials, and existing masonry walls to produce temperatures between 40 and 120 deg F (4 and 49 deg C).
2. When mean daily air temperature is below 40 deg F (4 deg C), provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for 7 days after repair and pointing.

D. Hot-Weather Requirements: Protect masonry repair and mortar-joint pointing when temperature and humidity conditions produce excessive evaporation of water from mortar and repair materials. Provide artificial shade and wind breaks and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F (32 deg C) and above unless otherwise indicated.

E. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.

F. Clean masonry surfaces only when air temperature is 40 deg F (4 deg C) and above and is predicted to remain so for at least 7 days after completion of cleaning.

1.10 COORDINATION

A. Coordinate masonry restoration and cleaning with public circulation patterns at Project site. Some work is near public circulation patterns. Public circulation patterns cannot be closed off entirely, and in places can be only temporarily redirected around small areas of work. Plan and execute the Work accordingly.

1.11 SEQUENCING AND SCHEDULING

A. Order replacement materials at earliest possible date to avoid delaying completion of the Work.

B. Order sand and portland cement for pointing mortar immediately after approval of mockups. Take delivery of and store at Project site a sufficient quantity to complete Project.

C. Perform masonry restoration work in the following sequence:

1. Remove plant growth.
2. Inspect for open mortar joints and repair before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
3. Clean masonry surfaces.
4. Rake out mortar from joints surrounding masonry to be replaced and from joints adjacent to masonry repairs along joints.
5. Repair masonry, including replacing existing masonry with new masonry materials.
6. Rake out mortar from joints to be repointed.
7. Point mortar and sealant joints.
8. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.

9. Inspect for open mortar joints and repair before cleaning to prevent the intrusion of water and other cleaning materials into the wall.

PART 2 - PRODUCTS

2.1 MASONRY MATERIALS

A. Face Brick: Provide face brick, including specially molded, ground, cut, or sawed shapes where required to complete masonry restoration work.

1. Provide units with colors, color variation within units, surface texture, size, and shape to match existing brickwork.

B. Building Brick: Provide building brick complying with ASTM C 62, of same vertical dimension as face brick, for masonry work concealed from view.

C. Salvaged Brick: Salvaged brick from demolition areas for reuse in patch and repair areas. Clean off residual mortar.

2.2 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type II, white where required for color matching of exposed mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Factory-Prepared Lime Putty: ASTM C 1489.

D. Quicklime: ASTM C 5, pulverized lime.

E. Mortar Sand: ASTM C 144 unless otherwise indicated.

1. Color: Provide natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
2. For pointing mortar, provide sand with rounded edges.
3. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.

F. Mortar Pigments: Natural and synthetic iron oxides, compounded for mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortars.

G. Water: Potable.

2.3 MANUFACTURED REPAIR MATERIALS

A. Masonry Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching masonry.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Cathedral Stone Products, Inc.; Jahn M100 Terra Cotta and Brick Repair Mortar.
   b. Conproco Corporation; Mimic.
   c. Edison Coatings, Inc.; Custom System 45.

2. Use formulation that is vapor- and water permeable (equal to or more than the masonry unit), exhibits low shrinkage, has lower modulus of elasticity than the masonry units being repaired, and develops high bond strength to all types of masonry.
3. Use formulation having working qualities and retardation control to permit forming and sculpturing where necessary.
4. Formulate patching compound used for patching brick in colors and textures to match each masonry unit being patched. Provide sufficient number of colors to enable matching the color, texture, and variation of each unit.

2.4 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Job-Mixed Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium polyphosphate, 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Job-Mixed Mold, Mildew, and Algae Remover: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium polyphosphate, 5 quarts (5 L) of 5 percent sodium hypochlorite (bleach), and 15 quarts (15 L) of hot water for every 5 gal. (20 L) of solution required.

E. Acidic Cleaner: Manufacturer's standard acidic masonry cleaner composed of hydrofluoric acid or ammonium bifluoride blended with other acids, detergents, wetting agents, and inhibitors.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABR Products, Inc.; 801 Heavy Duty Masonry Cleaner.
   b. Diedrich Technologies Inc.; Diedrich 101 Masonry Restorer or Diedrich 101G Granite, Terra Cotta, and Brick Cleaner.
   c. Dumond Chemicals, Inc.; Safe n' Easy Ultimate Stone and Masonry Cleaner or Safe n' Easy Heavy Duty Restoration Cleaner.
   d. EaCo Chem, Inc.; GS-Restoration or HD-Acid

e. Hydroclean, Hydrochemical Techniques, Inc.; Hydroclean Brick, Granite, Sandstone and Terra Cotta Cleaner (HT-626).
f. Price Research, Ltd.; Price Heavy Duty Restoration Cleaner or Price Restoration Cleaner.
g. PROSOCO; Enviro Klean Restoration Cleaner or Sure Klean Heavy-Duty Restoration Cleaner.

2.5 ACCESSORY MATERIALS

A. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, and polished stone surfaces from damaging effects of acidic and alkaline masonry cleaners.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABR Products, Inc.; Rubber Mask.
b. Price Research, Ltd.; Price Mask.
c. PROSOCO; Sure Klean Strippable Masking.

B. Masonry Repair Anchors, Expansion Type: Mechanical fasteners designed for masonry veneer stabilization consisting of 1/4-inch- (6-mm-) diameter, Type 304 stainless-steel rod with brass expanding shells at each end and water-shedding washer in the middle. Expanding shells shall be designed to provide positive mechanical anchorage to veneer on one end and backup masonry on the other.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BLOK-LOK Limited; Torq-Lok.
b. Dur-O-Wal, a division of Dayton Superior; Dur-O-Wal Repair Anchor.
c. Hohmann & Barnard, Inc.; #521RA-B Restoration Anchor.

C. Masonry Repair Anchors, Spiral Type: Type 304 stainless-steel spiral rods designed to anchor to backing and veneer. Anchors are flexible in plane of veneer but rigid perpendicular to it.

1. Provide adhesive-installed anchors complete with manufacturer's standard epoxy adhesive and injection tubes, or other devices required for installation.
2. Provide driven-in anchors designed to be installed in drilled holes and relying on screw effect rather than adhesive to secure them to backup and veneer.
3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BLOK-LOK Limited; Spira-Lok.
b. Dur-O-Wal, a division of Dayton Superior; Dur-O-Pair Resin Anchor or Dur-O-Flex Friction Pin Anchor.
c. Heckmann Building Products Inc.; #391 Remedial Tie.

d. Hohmann & Barnard, Inc.; Helix Spiro-Ties.

D. Masonry Repair Anchors, Rod/Screen Tube Type: Stainless-steel screen tube with or without Type 304 stainless-steel rod, adhesive installed by injection with manufacturer's standard epoxy adhesive, complete with other devices required for installation.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BLOK-LOK Limited; Chem-Lok.
b. Hohmann & Barnard, Inc.; #520RA.

E. Sealant Materials:

1. Provide manufacturer's standard chemically curing, elastomeric sealant(s) of base polymer and characteristics indicated below that comply with applicable requirements in Division 07 Section "Joint Sealants."

a. Single-component, nonsag urethane sealant.

2. Colors: Provide colors of exposed sealants to match colors of masonry adjoining installed sealant unless otherwise indicated.
3. Ground-Mortar Aggregate: Custom crushed and ground pointing mortar sand or existing mortar retrieved from joints. Grind to a particle size that matches the adjacent mortar aggregate and color. Remove all fines passing the 100 sieve.

F. Joint-Sealant Backing:

1. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or Type B (bicellular material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
2. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where acceptable.

G. Setting Buttons: Resilient plastic buttons, nonstaining to masonry, sized to suit joint thicknesses and bed depths of masonry units without intruding into required depths of pointing materials.

H. Masking Tape: Nonstaining, nonabsorbent material, compatible with pointing mortar, joint primers, sealants, and surfaces adjacent to joints; that will easily come off entirely, including adhesive.

I. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with MPI #79, Alkyd Anticorrosive Metal Primer or SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.

1. Use coating requiring no better than SSPC-SP 2, "Hand Tool Cleaning" surface preparation according to manufacturer's literature or certified statement.
2. Use coating with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

J. Miscellaneous Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.
2. Little possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could do the following:

a. Remove, alter, or in any way harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in contract.
b. Leave a residue on surfaces.

2.6 MORTAR MIXES

A. Preparing Lime Putty: Slake quicklime and prepare lime putty according to appendix to ASTM C 5 and manufacturer's written instructions.

B. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

C. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not exceed a pigment-to-cement ratio of 1:10 by weight.

D. Do not use admixtures in mortar unless otherwise indicated.

E. Mortar Proportions: Mix mortar materials in the following proportions:

1. Pointing Mortar for Brick: 1 part portland cement, 2 parts lime, and 6 parts sand.

a. Add mortar pigments to produce mortar colors required.

2. Rebuilding (Setting) Mortar: Same as pointing mortar.

2.7 CHEMICAL CLEANING SOLUTIONS

A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended by chemical-cleaner manufacturer.

B. Acidic Cleaner Solution for Brick: Dilute with water to produce hydrofluoric acid content of 3 percent or less, but not greater than that recommended by chemical-cleaner manufacturer.

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm resulting from masonry restoration work.

1. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of restoration and cleaning work.

B. Comply with chemical-cleaner manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical-cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proven to resist chemical cleaners used unless chemical cleaners being used will not damage adjacent surfaces. Use materials that contain only waterproof, UV-resistant adhesives. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
2. Keep wall wet below area being cleaned to prevent streaking from runoff.
3. Do not clean masonry during winds of sufficient force to spread cleaning solutions to unprotected surfaces.
4. Neutralize and collect alkaline and acid wastes for disposal off Owner's property.
5. Dispose of runoff from cleaning operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

C. Prevent mortar from staining face of surrounding masonry and other surfaces.

1. Cover sills, ledges, and projections to protect from mortar droppings.
2. Keep wall area wet below rebuilding and pointing work to discourage mortar from adhering.

3. Immediately remove mortar in contact with exposed masonry and other surfaces.
4. Clean mortar splatters from scaffolding at end of each day.

D. Remove downspouts adjacent to masonry and store during masonry restoration and cleaning. Reinstall when masonry restoration and cleaning are complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 BRICK REMOVAL AND REPLACEMENT

A. At locations indicated, remove bricks that are damaged, spalled, or deteriorated or are to be reused. Carefully demolish or remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

1. When removing single bricks, remove material from center of brick and work toward outside edges.

B. Support and protect remaining masonry that surrounds removal area. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.

C. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.

D. Remove in an undamaged condition as many whole bricks as possible.

1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
3. Store brick for reuse. Store off ground, on skids, and protected from weather.
4. Deliver cleaned brick not required for reuse to Owner unless otherwise indicated.

E. Clean bricks surrounding removal areas by removing mortar, dust, and loose particles in preparation for replacement.

F. Replace removed damaged brick with other removed brick and salvaged brick in good quality, where possible, or with new brick matching existing brick, including size. Do not use broken units unless they can be cut to usable size.

G. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

1. Maintain joint width for replacement units to match existing joints.
2. Use setting buttons or shims to set units accurately spaced with uniform joints.

H. Lay replacement brick with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per

min. (30 g/194 sq. cm per min.). Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.

1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
2. Rake out mortar used for laying brick before mortar sets and point new mortar joints in repaired area to comply with requirements for repointing existing masonry, and at same time as repointing of surrounding area.
3. When mortar is sufficiently hard to support units, remove shims and other devices interfering with pointing of joints.

3.3 MASONRY UNIT PATCHING

A. Patch the following masonry units unless another type of replacement or repair is indicated:

1. Units indicated to be patched.
2. Units with holes.
3. Units with chipped edges or corners.
4. Units with small areas of deep deterioration.

B. Remove and replace existing patches unless otherwise indicated or approved by Architect.

C. Patching Bricks:

1. Remove loose material from masonry surface. Carefully remove additional material so patch will not have feathered edges but will have square or slightly undercut edges on area to be patched and will be at least 1/4 inch (6 mm) thick, but not less than recommended by patching compound manufacturer.
2. Mask adjacent mortar joint or rake out for repointing if patch will extend to edge of masonry unit.
3. Mix patching compound in individual batches to match each unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.
4. Rinse surface to be patched and leave damp, but without standing water.
5. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.
6. Place patching compound in layers as recommended by patching compound manufacturer, but not less than 1/4 inch (6 mm) or more than 2 inches (50 mm) thick. Roughen surface of each layer to provide a key for next layer.
7. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of the masonry unit. Shape and finish surface before or after curing, as determined by testing, to best match existing masonry unit.
8. Keep each layer damp for 72 hours or until patching compound has set.

3.4 WIDENING JOINTS

A. Do not widen a joint, except where indicated or approved by Architect.

B. Location Guideline: Where an existing masonry unit abuts another or the joint is less than 1/8 inch (3 mm), widen the joint for length indicated and to depth required for repointing after obtaining Architect's approval.

C. Carefully perform widening by cutting, grinding, routing, or filing procedures demonstrated in an approved mockup.

D. Widen joint to width equal to or less than predominant width of other joints on building. Make sides of widened joint uniform and parallel. Ensure that edges of units along widened joint are in alignment with joint edges at unaltered joints.

3.5 CLEANING MASONRY, GENERAL

A. Proceed with cleaning in an orderly manner; work from top to bottom of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water will not wash over cleaned, dry surfaces.

B. Use only those cleaning methods indicated for each masonry material and location.

1. Do not use wire brushes or brushes that are not resistant to chemical cleaner being used. Do not use plastic-bristle brushes if natural-fiber brushes will resist chemical cleaner being used.
2. Use spray equipment that provides controlled application at volume and pressure indicated, measured at spray tip. Adjust pressure and volume to ensure that cleaning methods do not damage masonry.

   a. Equip units with pressure gages.

3. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with cone-shaped spray tip.

C. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces.

D. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces to comply with chemical-cleaner manufacturer's written instructions; use brush or spray application. Do not spray apply at pressures exceeding 50 psi (345 kPa). Do not allow chemicals to remain on surface for periods longer than those indicated or recommended by manufacturer.

E. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.

1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

F. After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

3.6 PRELIMINARY CLEANING

A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing to dry as long as possible before removal. Remove loose soil and debris from open masonry joints to whatever depth they occur.

B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to cleaning methods being used. Extraneous substances include paint, calking, asphalt, and tar.

1. Carefully remove heavy accumulations of material from surface of masonry with a sharp chisel. Do not scratch or chip masonry surface.

2. Remove asphalt and tar with solvent-type paint remover.

a. Apply paint remover only to asphalt and tar by brush without prewetting.
b. Allow paint remover to remain on surface for 10 to 30 minutes.
c. Repeat application if needed.

3.7 CLEANING BRICKWORK

A. Mold, Mildew, and Algae Removal:

1. Wet masonry with hot water applied by low-pressure spray.
2. Apply mold, mildew, and algae remover by brush or low-pressure spray.
3. Scrub masonry with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that masonry surface remains wet.
4. Rinse with hot water applied by low-pressure spray to remove mold, mildew, and algae remover and soil.
5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.

B. Acidic Chemical Cleaning:

1. Wet masonry with cold water applied by low-pressure spray.
2. Apply cleaner to masonry in two applications by brush or low-pressure spray. Let cleaner remain on surface for period indicated below:

a. As recommended by chemical-cleaner manufacturer.
b. As established by mockup.

c. Two to three minutes.

3. Rinse with cold water applied by low-pressure spray to remove chemicals and soil.
4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use a steam cleaning.

3.8 REPOINTING MASONRY

A. Rake out and repoint joints to the following extent:

1. All joints in areas indicated.
2. Joints where mortar is missing or where they contain holes.
3. Cracked joints where cracks can be penetrated at least 1/4 inch (6 mm) by a knife blade 0.027 inch (0.7 mm) thick.
4. Cracked joints where cracks are 1/8 inch (3 mm or more in width and of any depth.
5. Joints where they sound hollow when tapped by metal object.
6. Joints where they are worn back 1/4 inch (6 mm) or more from surface.
7. Joints where they are deteriorated to point that mortar can be easily removed by hand, without tools.
8. Joints where they have been filled with substances other than mortar.
9. Joints indicated as sealant-filled joints.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of joint width plus 1/8 inch (3 mm), but not less than 1/2 inch (13 mm) or not less than that required to expose sound, unweathered mortar.
2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of masonry units or widen joints. Replace or patch damaged masonry units as directed by Architect.

   a. Cut out mortar by hand with chisel and resilient mallet. Do not use power-operated grinders without Architect's written approval based on approved quality-control program.
   b. Cut out center of mortar bed joints using angle grinders with diamond-impregnated metal blades. Remove remaining mortar by hand with chisel and resilient mallet. Strictly adhere to approved quality-control program.

D. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch (9 mm) until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
3. After low areas have been filled to same depth as remaining joints, point all joints by placing mortar in layers not greater than 3/8 inch (9 mm). Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing masonry units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours including weekends and holidays.

    a. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.
    b. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.

6. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

F. Pointing with Sealant:

1. After raking out, keep joints dry and free of mortar and debris.
2. Clean and prepare joint surfaces according to Division 07 Section "Joint Sealants." Prime joint surfaces unless sealant manufacturer recommends against priming. Do not allow primer to spill or migrate onto adjoining surfaces.
3. Fill sealant joints with specified joint sealant according to Division 07 Section "Joint Sealants" and the following:

    a. Install cylindrical sealant backing beneath the sealant, except where space is insufficient. There, install bond-breaker tape.
    b. Install sealant using only proven installation techniques that will ensure that sealant will be deposited in a uniform, continuous ribbon, without gaps or air pockets, and with complete wetting of the joint bond surfaces equally on both sides. Fill joint flush with surrounding masonry and matching the contour of adjoining mortar joints.
    c. Install sealant as recommended by sealant manufacturer but within the following general limitations, measured at the center (thin) section of the bead:

1) Fill joints to a depth equal to joint width, but not more than 1/2 inch (13 mm) deep or less than 1/4 inch (6 mm) deep.

d. Immediately after first tooling, apply ground-mortar aggregate to sealant, gently pushing aggregate into the surface of sealant. Retool sealant to form smooth, uniform beads, slightly concave. Remove excess sealant and aggregate from surfaces adjacent to joint.

e. Do not allow sealant to overflow or spill onto adjoining surfaces, or to migrate into the voids of adjoining surfaces, particularly rough textures. Remove excess and spillage of sealant promptly as the work progresses. Clean adjoining surfaces by the means necessary to eliminate evidence of spillage, without damage to adjoining surfaces or finishes, as demonstrated in an approved mockup.

4. Cure sealant according to Division 07 Section "Joint Sealants."

G. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.9 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, spray applied at low pressure.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

B. Wash adjacent woodwork and other nonmasonry surfaces. Use detergent and soft brushes or cloths.

C. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.

D. Sweep and rake adjacent pavement and grounds to remove mortar and debris. Where necessary, pressure wash pavement surfaces to remove mortar, dust, dirt, and stains.

3.10 FIELD QUALITY CONTROL

A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare test reports. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.

B. Architect's Project Representatives: Architect will assign Project representatives to help carry out Architect's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Architect's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.

C. Notify inspectors and Architect's Project representatives in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until inspectors and Architect's Project representatives have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.

END OF SECTION 040120

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Face brick.
3. Building (common) brick.
4. Mortar and grout.
5. Steel reinforcing bars.
6. Masonry joint reinforcement.
7. Ties and anchors.
8. Embedded flashing.
9. Miscellaneous masonry accessories.

B. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" for installing dovetail slots for masonry anchors.
2. Division 05 Section "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
3. Division 05 Section "Metal Fabrications" for furnishing steel lintels and shelf angles for unit masonry.
4. Division 07 Section "Water Repellents" for water repellents applied to unit masonry.
5. Division 07 Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.
6. Division 08 Section "Louvers and Vents" for wall vents (brick vents).

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
2. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
3. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
4. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Stone Trim Units: Show sizes, profiles, and locations of each stone trim unit required.
3. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
4. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

D. Samples for Initial Selection:

1. Face brick.
2. Colored mortar.
3. Weep holes/vents.

E. Samples for Verification: For each type and color of the following:

1. Face brick.
2. Special brick shapes.
3. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.

4. Weep holes and vents.
5. Accessories embedded in masonry.

1.6 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Qualification Data: For testing agency.

C. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.
b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
c. For exposed brick, include test report for efflorescence according to ASTM C 67.
d. For masonry units, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Reinforcing bars.
6. Joint reinforcement.
7. Anchors, ties, and metal accessories.

D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

E. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Division 01 Section "Quality Requirements" for mockups.

1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 48 inches (1200 mm) long by 48 inches (1200 mm) high by full thickness.
2. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
3. Clean one-half of exposed faces of panels with masonry cleaner indicated.
4. Protect approved sample panels from the elements with weather-resistant membrane.
5. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.

    a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

A. Regional Materials: CMUs shall be manufactured within 500 miles (800 km) of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

C. Integral Water Repellent: Provide units made with integral water repellent for exposed units.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) ACM Chemistries; RainBloc.
2) BASF Aktiengesellschaft; Rheopel Plus.
3) Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block.

D. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of1900 psi.
2. Density Classification: Normal weight.
3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.

4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

2.3 BRICK

A. Regional Materials: Brick shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

C. Face Brick: Facing brick complying with ASTM C 216.

1. Products: Match existing
2. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67.
3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
4. Size (Actual Dimensions): Match existing.
5. Application: Use where brick is exposed unless otherwise indicated.
6. Where shown to "match existing," provide face brick matching color range, texture, and size of existing adjacent brickwork.

D. Building (Common) Brick: ASTM C 62,

1. Size: Match size of face brick.
2. Application: Use where brick is indicated for concealed locations. Face brick complying with requirements for grade, compressive strength, and size indicated for building brick may be substituted for building brick.

2.4 MORTAR AND GROUT MATERIALS

A. Regional Materials: Aggregate for mortar and grout, cement, and lime shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

C. Hydrated Lime: ASTM C 207, Type S.

D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

E. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.

F. Aggregate for Grout: ASTM C 404.

G. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for structural-clay tile facing units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.

H. Refractory Mortar Mix: Ground fireclay or non-water-soluble, calcium aluminate, medium-duty refractory mortar that passes ASTM C 199 test; or an equivalent product acceptable to authorities having jurisdiction.

I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Euclid Chemical Company (The); Accelguard 80.
b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.

J. Water: Potable.

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

1. Exterior Walls: Hot-dip galvanized, carbon steel.
2. Wire Size for Side Rods: 0.187-inch (4.76-mm) diameter.
3. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
4. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
5. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.6 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:

a. Structural Performance Characteristics: Capable of withstanding a 100-lbf (445-N) load in both tension and compression without deforming or developing play in excess of 0.05 inch (1.3 mm).

2. Contractor's Option: Unless otherwise indicated, provide any of the following types of anchors:

2.7 MISCELLANEOUS ANCHORS

A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.

B. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where

indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

C. Postinstalled Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 unless otherwise indicated.
3. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.8 EMBEDDED FLASHING MATERIALS

A. Flexible Flashing: Use the following unless otherwise indicated:

1. Copper-Laminated Flashing: 5-oz./sq. ft. (1.5-kg/sq. m) copper sheet bonded between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Advanced Building Products Inc.; Copper Fabric Flashing.
2) BMWCO, Inc.: Evacu-Flash.
3) Dayton Superior Corporation, Dur-O-Wal Division; Copper Fabric Thru-Wall Flashing.
4) Hohmann & Barnard, Inc.; H & B C-Fab Flashing.
5) Phoenix Building Products; Type FCC-Fabric Covered Copper.
6) Sandell Manufacturing Co., Inc.; Copper Fabric Flashing.
7) STS Coatings, Inc.; Gorilla Flash.
8) York Manufacturing, Inc.; Multi-Flash 500.

B. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a sealant stop.
4. Where flashing is fully concealed, use flexible flashing.

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products: Use the following unless otherwise indicated:

1. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, 3/8 by 1-1/2 by 3-1/2 inches (9 by 38 by 89 mm) long.

E. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.10 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Diedrich Technologies, Inc.
    b. EaCo Chem, Inc.
    c. ProSoCo, Inc.

2.11 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime or masonry cement mortar.
4. For reinforced masonry, use portland cement-lime or masonry cement mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type N.
3. For mortar parge coats, use Type S or Type N.
4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
5. For interior non-load-bearing partitions, Type O may be used instead of Type N.

D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches (100-mm). Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

1. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 1/2 inch (13 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.

3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Form expansion joints in brick as follows:

1. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch (10 mm) for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."

D. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 3/8 inch (10 mm).

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.9 LINTELS

A. Install steel lintels where indicated.

B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.10 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches (200 mm); with upper edge tucked under building paper or building wrap, lapping at least 4 inches (100 mm).
3. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
4. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with

elastomeric sealant complying with requirements in Division 07 Section "Joint Sealants" for application indicated.

5. Install metal sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Division 07 Section "Joint Sealants" for application indicated.
6. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.
7. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
8. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

E. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use specified weep/vent products to form weep holes.
2. Space weep holes 24 inches (600 mm) o.c. unless otherwise indicated.
3. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
4. Trim wicking material flush with outside face of wall after mortar has set.

F. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches (50 mm), to maintain drainage.

1. Fill cavities full height by placing pea gravel in cavities as masonry is laid so that at any point masonry does not extend more than 24 inches (600 mm) above top of pea gravel.

G. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.11 REINFORCED UNIT MASONRY INSTALLATION

A. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

B. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches (1520 mm..

3.12 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Level 1 special inspections according to the "International Building Code."

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.13 PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in 2 uniform coats to a total thickness of 3/4 inch (19 mm). Dampen wall before applying first coat and scarify first coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot (3 mm per 300 mm). Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.14 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.15 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches (100 mm) in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 31 Section "Earth Moving."
3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Structural steel.
2. Grout.

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 COORDINATION

A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

C. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

D. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, shop-painting applicators and testing agency.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.
6. Nonshrink grout.

F. Survey of existing conditions.

G. Source quality-control reports.

H. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: Engage and experienced installer who has completed structural steel work similar in material, design and extent to that indicated for this project and with a record of successful in service performance.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

E. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated.

B. Moment Connections: Type PR, partially restrained.

C. Construction: Moment frame.

2.2 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. W-Shapes: ASTM A 992/A 992M.

C. Channels, Angles, M, S-Shapes: ASTM A 36/A 36M.

D. Plate and Bar: ASTM A 36/A 36 and ASTM A 572/A 572M, Grade 50 (345).

E. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B structural tubing.

F. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.

1. Weight Class: As indicated.
2. Finish: Black except where indicated to be galvanized.

G. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy-hex steel structural bolt[or tension-control, bolt-nut-washer assemblies with splined ends;

ASTM A 563, Grade DH, (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 490 (ASTM F 959M, Type 10.9), compressible-washer type with plain finish.

C. Unheaded Anchor Rods: ASTM F 1554, Grade 36..

1. Configuration: Hooked.
2. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
5. Finish: Plain unless noted otherwise.

D. Headed Anchor Rods: ASTM F 1554, Grade 36 straight.

1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
4. Finish: Plain unless noted otherwise.

E. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
2. Washers: A 36/A 36M carbon steel.
3. Finish: Plain unless noted otherwise.

F. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

2.4 PRIMER

A. Primer: SSPC-Paint 25, Type or Type II, zinc oxide, alkyd, linseed oil primer.

B. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

C. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.5 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.

1. Fabricate beams with rolling camber up.
2. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
3. Mark and match-mark materials for field assembly.
4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill,]or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning", SSPC-SP 2, "Hand Tool Cleaning" or SSPC-SP 3, "Power Tool Cleaning."

F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tighten unless noted otherwise.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.8 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels attached to structural-steel frame and located in exterior walls.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Baseplates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow tocure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened or Slip critical.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION 051200

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof deck.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
2. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
3. Section 099113 "Exterior Painting" for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

C. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.
2. Acoustical roof deck.

D. Evaluation Reports: For steel deck.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

C. Electrical Raceway Units: Provide UL-labeled cellular floor-deck units complying with UL 209 and listed in UL's "Electrical Construction Equipment Directory" for use with standard header ducts and outlets for electrical distribution systems.

D. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

C. Rusty or mud spattered decking shall not be erected.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

D. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Canam United States; Canam Group Inc.
2. CMC Joist & Deck.
3. Consolidated Systems, Inc.; Metal Dek Group.
4. Epic Metals Corporation.
5. New Millennium Building Systems, LLC.
6. Nucor Corp.; Vulcraft Group.
7. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230),G60 (Z180) zinc coating.
2. Deck Profile: As indicated.
3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Span Condition: Triple span or more.
6. Side Laps: Overlapped.

2.3 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

G. Galvanizing Repair Paint: ASTM A 780.

H. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

J. All openings greater than 12 inches shall be reinforced with angle framing according to details on structural drawings.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to truss supporting members with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:

1. Spacing: Fasten edge and interior ribs of deck units with a minimum of two fasteners per deck unit at each support. Space welds 12 inches (305 mm) apart in the field of roof and 6 inches (150 mm) apart in roof corners and perimeter.
2. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 36 inches (914 mm), and as follows:

1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

1. End Joints: Lapped 2 inches (51 mm) minimum.

D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. mechanically fasten to substrate to provide a complete deck installation.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.

1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

D. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior non-load-bearing wall framing.
2. Ceiling joist framing.
3. Soffit framing.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cold-formed steel framing product and accessory.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

C. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.

2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

D. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. ClarkWestern Building Systems, Inc.
   2. Design Shapes in Steel.
   3. Dietrich Metal Framing; a Worthington Industries Company.
   4. MarinoWARE.
   5. Olmar Supply, Inc.
   6. Quail Run Building Materials, Inc.
   7. Steel Construction Systems.
   8. Telling Industries, LLC.
   9. United Steel Manufacturing.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

   1. Grade: As required by structural performance.
   2. Coating: G60 (Z180), A60 (ZF180), AZ50 (AZ150), or GF30 (ZGF90).

C. Steel Sheet for Vertical Deflection or Drift Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

   1. Grade: 33 (230).
   2. Coating: G60 (Z180).

2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
   2. Flange Width: 1 $^{5}/_{8}$ inch: (41mm)

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

   1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
   2. Flange Width: 1-1/4 inches (32 mm).

C. Vertical Deflection Clips: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      a. AllSteel & Gypsum Products, Inc.
      b. ClarkWestern Building Systems, Inc.
      c. Dietrich Metal Framing; a Worthington Industries company.
      d. MarinoWARE.
      e. SCAFCO Corporation.
      f. Steel Network, Inc. (The).
      g. Steeler, Inc.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

   1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
   2. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures.

2.5 CEILING JOIST FRAMING

A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with standard holes, with stiffened flanges, and as follows:

   1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
   2. Flange Width: 1-5/8 inches (41 mm), minimum.

2.6 SOFFIT FRAMING

A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
2. Flange Width: 1-5/8 inches (41 mm), minimum.

2.7 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.8 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.9 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A 780.

B. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.3 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.

3. Connect vertical deflection clips to infill studs and anchor to building structure.
4. Connect drift clips to cold-formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.

1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches (450 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

   a. Install solid blocking at 96-inch (2440-mm) centers.

2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
3. Or: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.4 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 054400 - COLD-FORMED METAL TRUSSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cold-formed steel trusses for roofs.

B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for cold-formed steel studs, joists, and rafters.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

C. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel trusses; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

D. Delegated-Design Submittal: For cold-formed steel trusses.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Miscellaneous structural clips and accessories.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified testing agency, or in-house testing with calibrated test equipment, indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel trusses from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Aegis Metal Framing.
2. Genesis Worldwide Inc.
3. Marino/WARE.
4. Nuconsteel, A Nucor Company.

5. Steel Construction Systems.
6. TrusSteel; an ITW company.
7. USA Frametek.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel trusses capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated.
2. Deflection Limits: Design trusses to withstand design loads without deflections greater than the following:
   a. Roof Trusses: Vertical deflection of 1/360 of the span.

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).

C. Cold-Formed Steel Framing Design Standards:

1. Floor and Roof Systems: Design according to AISI S210.
2. Lateral Design: Design according to AISI S213.
3. Roof Trusses: Design according to AISI S214.

D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COLD-FORMED STEEL TRUSS MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Steel Sheet: ASTM A 1003/A 1003M, structural grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As required by structural performance.
2. Coating: G60 (Z180), A60 (ZF180), AZ50 (AZ150), or GF30 (ZGF90).

2.4 ROOF TRUSSES

A. Roof Truss Members: Manufacturer's standard C-shaped steel sections.

1. Connecting Flange Width: 1-5/8 inches (41 mm) minimum at top and bottom chords connecting to sheathing or other directly fastened construction.
2. Minimum Base-Metal Thickness: .0428 inch (1.09 mm).

2.5 ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, structural grade, Type H, metallic coated, of same grade and coating weight used for truss members.

B. Provide accessories of manufacturer's standard thickness and configuration unless otherwise indicated.

2.6 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and Appendix D in ACI 318, greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

C. Power-Actuated Fasteners: Fastener system of type suitable for application, fabricated from corrosion-resistant materials, with capability to sustain, without failure, allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

E. Welding Electrodes: Comply with AWS standards.

2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.

B. Shims: Load bearing, of high-density multimonomer plastic, nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

2.8 FABRICATION

A. Fabricate cold-formed steel trusses and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate trusses using jigs or templates.
2. Cut truss members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel truss members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator.

a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

4. Fasten other materials to cold-formed steel trusses by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace trusses to withstand handling, delivery, and erection stresses. Lift fabricated trusses to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting cold-formed steel trusses for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed steel trusses without reducing thickness of fire-

resistive materials below that is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION

A. Install, bridge, and brace cold-formed steel trusses according to AISI S200, AISI S214, AISI's "Code of Standard Practice for Cold-Formed Steel Structural Framing," and manufacturer's written instructions unless more stringent requirements are indicated.

B. Install cold-formed steel trusses and accessories plumb, square, and true to line, and with connections securely fastened.

1. Fasten cold-formed steel trusses by welding or mechanical fasteners.

a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings; comply with requirements for spacing, edge distances, and screw penetration.

C. Install temporary bracing and supports. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

D. Truss Spacing: As indicated.

E. Do not alter, cut, or remove framing members or connections of trusses.

F. Erect trusses with plane of truss webs plumb and parallel to each other, align, and accurately position at spacings indicated.

G. Erect trusses without damaging framing members or connections.

H. Coordinate with wall framing to align webs of bottom chords and load-bearing studs or continuously reinforce track to transfer loads to structure. Anchor trusses securely at all bearing points.

I. Install continuous bridging and permanently brace trusses as indicated on Shop Drawings and designed according to CFSEI's TechNote 551e, "Design Guide: Permanent Bracing of Cold-Formed Steel Trusses."

J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual trusses no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Field and shop welds will be subject to testing and inspecting.

C. Prepare test and inspection reports.

3.5 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal trusses are without damage or deterioration at time of Substantial Completion.

END OF SECTION 054400

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel framing and supports for mechanical and electrical equipment.
2. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Division 04 Section "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
3. Division 05 Section "Structural Steel Framing."

1.3 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Paint products.
3. Grout.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

C. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

B. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.

C. Welding certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.

C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

E. Rolled-Stainless-Steel Floor Plate: ASTM A 793.

F. Steel Tubing: ASTM A 500, cold-formed steel tubing.

G. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.

H. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.3 NONFERROUS METALS

A. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

C. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

D. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

E. Bronze Plate, Sheet, Strip, and Bars: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper).

F. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (extruded architectural bronze).

G. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).

H. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500.

I. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

2.4 FASTENERS

A. General: Unless otherwise indicated, provide stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless-steel fasteners for fastening stainless steel.
3. Provide stainless-steel fasteners for fastening nickel silver.
4. Provide bronze fasteners for fastening bronze.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3 (ASTM A 325M, Type 3); with hex nuts, ASTM A 563, Grade C3 (ASTM A 563M, Class 8S3); and, where indicated, flat washers.

D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593 (ASTM F 738M); with hex nuts, ASTM F 594 (ASTM F 836M); and, where indicated, flat washers; Alloy Group 1 (A1).

E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Eyebolts: ASTM A 489.

G. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

H. Lag Screws: ASME B18.2.1 (ASME B18.2.3.8M).

I. Wood Screws: Flat head, ASME B18.6.1.

J. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).

K. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).

L. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

M. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

N. Post-Installed Anchors:

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

O. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Primers: Provide primers that comply with Division 09 painting Sections.

D. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

E. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

H. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.

I. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

J. Concrete: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.6 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.8 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Galvanize shelf angles located in exterior walls.

D. Prime shelf angles located in exterior walls with zinc-rich primer.

E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.9 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

2.10 METAL DOWNSPOUT BOOTS

A. Provide downspout boots made from cast iron in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.

1. Outlet: Vertical, to discharge into pipe.

B. Prime cast iron downspout boots with zinc-rich primer.

2.11 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates.

2.12 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches (200 mm) unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.13 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.14 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.15 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with primers specified in Division 09 painting Sections unless zinc-rich primer is indicated.

C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Division 09 Section "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Items: SSPC-SP 3, "Power Tool Cleaning."

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.16 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING PIPE GUARDS

A. Provide pipe guards at exposed vertical pipes in parking garage where not protected by curbs or other barriers. Install by bolting to wall or column with expansion anchors. Provide four 3/4-inch (19-mm) bolts at each pipe guard. Mount pipe guards with top edge 26 inches (660 mm) above driving surface.

3.4 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Rooftop equipment bases and support curbs.
3. Wood blocking and nailers.
4. Wood furring.
5. Plywood backing panels.

B. Related Requirements:

1. Division 06 Section "Sheathing."
2. Division 06 finish carpentry Sections for nonstructural carpentry items exposed to view and not specified in another Section.
3. Division 31 Section "Termite Control" for site application of borate treatment to wood framing.

1.3 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NHLA: National Hardwood Lumber Association.
3. NLGA: National Lumber Grades Authority.
4. SPIB: The Southern Pine Inspection Bureau.
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. LEED Submittals:

1. Certificates for Credit MR 6: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Power-driven fasteners.
3. Powder-actuated fasteners.
4. Expansion anchors.
5. Metal framing anchors.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Certified Wood: Lumber and plywood shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
4. Provide dressed lumber, S4S, unless otherwise indicated.

C. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawl spaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.

B. For items of dimension lumber size, provide Standard, Stud, or No. 3 grade lumber and any of the following species:

1. Hem-fir (north); NLGA.
2. Mixed southern pine; SPIB.
3. Spruce-pine-fir; NLGA.
4. Hem-fir; WCLIB or WWPA.
5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
6. Western woods; WCLIB or WWPA.
7. Northern species; NLGA.
8. Eastern softwoods; NeLMA.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine, No. 3 grade; SPIB.

2. Hem-fir or hem-fir (north), Standard or No. 3 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir, Standard or No. 3 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
4. Eastern softwoods, No. 3 Common grade; NELMA.
5. Northern species, No. 3 Common grade; NLGA.
6. Western woods, Standard or No. 3 Common grade; WCLIB or WWPA.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exterior, C-C Plugged in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

1. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

G. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.6 METAL FRAMING ANCHORS

A. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cleveland Steel Specialty Co.
2. KC Metals Products, Inc.
3. Phoenix Metal Products, Inc.
4. Simpson Strong-Tie Co., Inc.
5. USP Structural Connectors.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.

1. Use for interior locations unless otherwise indicated.

C. Hot-Dip Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.

1. Use for wood-preservative-treated lumber and where indicated.

2.7 MISCELLANEOUS MATERIALS

A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

C. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

E. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

F. Do not splice structural members between supports unless otherwise indicated.

G. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.

H. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

I. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

J. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

K. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal-size (19-by-38-mm actual-size) furring vertically at 16 inches (406 mm) o.c.

3.4 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wall sheathing.

B. Related Requirements:

1. Division 06 Section "Miscellaneous Rough Carpentry" for plywood backing panels.
2. Division 07 Section "Weather Barriers" for water-resistive barrier applied over wall sheathing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. LEED Submittals:

1. Certificates for Credit MR 6: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
3. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WALL SHEATHING

A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. CertainTeed Corporation; GlasRoc.
   b. G-P Gypsum Corporation; Dens-Glass Gold.
   c. National Gypsum Company; Gold Bond e(2)XP.
   d. Temple-Inland Inc.; GreenGlass
   e. United States Gypsum Co.; Securock.

2. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick.
3. Size: 48 by 96 inches (1219 by 2438 mm) for vertical installation.

2.2 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C 954.

2.3 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Division 07 Section "Joint Sealants."

B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

2.4 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

1. Adhesives shall have a VOC content of 50> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to cold-formed metal framing with screws.

2. Install boards with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
3. Install boards with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of boards.
2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

D. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of boards.
2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

E. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 061600

SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior trim, including non-fire-rated interior door and sidelight frames.
2. Interior ornamental wood columns.

B. Related Requirements:

1. Division 06 Section "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
2. Division 09 Section "Interior Painting" for priming and backpriming of interior finish carpentry.

1.3 DEFINITIONS

A. MDF: Medium-density fiberboard.

B. MDO: Plywood with a medium-density overlay on the face.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

1. Include data for wood-preservative treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material.
2. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.

4. Include copies of warranties from chemical-treatment manufacturers for each type of treatment.

B. LEED Submittals:

1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
2. Certificates for Credit MR 6: Chain-of-custody certificates indicating that composite wood products comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
3. Product Data for Credit IEQ 4.1: For adhesives and glues used at Project site, documentation including printed statement of VOC content.
4. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.

C. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.

D. Samples for Verification:

1. For each species and cut of lumber and panel products with non-factory-applied finish, with 1/2 of exposed surface finished, 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.
2. For each finish system and color of lumber and panel products with factory-applied finish, 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.
3. For interior wood columns, include quarter-section Samples of cap, base, plinth, and 6-inch- (150-mm-) long quarter-section Sample of shaft.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For fire-retardant-treated wood, from ICC-ES.

B. Sample Warranty: For manufacturer's warranty.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

B. Deliver interior finish carpentry materials only when environmental conditions meet requirements specified for installation areas. If interior finish carpentry materials must be

stored in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.8 WARRANTY

A. Manufacturer's Warranty for Columns: Manufacturer agrees to repair or replace columns that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Columns: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Regional Materials: The following wood products shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

1. Interior trim.
2. Interior ornamental wood columns.

B. Certified Wood: The following wood products shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":

1. Interior trim.
2. Interior ornamental wood columns.

C. Low-Emitting Materials: Composite wood products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the

Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Lumber: DOC PS 20 and the following grading rules:

1. NeLMA: Northeastern Lumber Manufacturers' Association, "Standard Grading Rules for Northeastern Lumber."
2. NHLA: National Hardwood Lumber Association, "Rules for the Measurement and Inspection of Hardwood & Cypress."
3. NLGA: National Lumber Grades Authority, "Standard Grading Rules for Canadian Lumber."
4. SPIB: The Southern Pine Inspection Bureau, "Standard Grading Rules for Southern Pine Lumber."
5. WCLIB: West Coast Lumber Inspection Bureau, Standard No. 17, "Grading Rules for West Coast Lumber."
6. WWPA: Western Wood Products Association, "Western Lumber Grading Rules."

E. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.

1. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

F. Softwood Plywood: DOC PS 1.

G. Hardboard: AHA A135.4.

H. MDF: ANSI A208.2, Grade 130, made with binder containing no urea-formaldehyde resin.

I. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea-formaldehyde resin.

J. Melamine-Faced Particleboard: Particleboard complying with ANSI A208.1, Grade M-2, finished on both faces with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

1. Color: As selected by Architect from manufacturer's full range.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2.

1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 18 percent respectively.
2. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

3. For exposed items indicated to receive transparent finish, do not use chemical formulations that contain colorants or that bleed through or otherwise adversely affect finishes.
4. Do not use material that is warped or does not comply with requirements for untreated material.
5. Mark lumber with treatment-quality mark of an inspection agency approved by the American Lumber Standard Committee's Board of Review.

    a. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

6. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

    a. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.

7. Application: Where indicated.

2.3 INTERIOR TRIM

A. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade: Red oak; Stain; NHLA.
2. Maximum Moisture Content: 13 percent.
3. Finger Jointing: Not allowed.
4. Gluing for Width: Not allowed.
5. Veneered Material: Not allowed.
6. Face Surface: Surfaced (smooth).
7. Matching: Selected for compatible grain and color.

B. Lumber Trim for Opaque Finish (Painted Finish):

1. Species and Grade: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine; Finish or 1 Common (Colonial); NeLMA, NLGA, or WWPA.
2. Maximum Moisture Content: 15 percent.
3. Finger Jointing: Allowed.
4. Face Surface: Surfaced (smooth).
5. Optional Material: Primed MDF of same actual dimensions as lumber indicated may be used in lieu of lumber.

2.4 ORNAMENTAL WOOD COLUMNS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Chadsworth's Incorporated.
2. Colonial Columns, Inc.
3. Hartmann-Sanders.
4. Melton Classics Incorporated.
5. Somerset Door & Column Company.
6. Turncraft Div.; Cascade Wood Products, Inc.
7. Worthington Millwork.

B. Factory fabricate columns for transparent finish from clear, kiln-dried **red oak**.

C. Factory fabricate columns for opaque finish from clear, kiln-dried eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine. Column staves may be finger jointed.

D. Shafts: Built up from tongue-and-groove staves joined with waterproof glue. Lathe turn shafts to provide base diameter indicated and true architectural entasis taper.

E. Capital and Base: Built up from wood components with waterproof glue. Turn circular elements on lathes.

F. Prime columns for opaque finish with one coat of interior wood primer compatible with specified topcoats.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

B. Low-Emitting Materials: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.

1. Wood glue shall have a VOC content of 30 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Installation Adhesive for Foam Plastic Moldings: Product recommended for indicated use by foam plastic molding manufacturer.

1. Adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Paneling Adhesive: Comply with paneling manufacturer's written recommendations for adhesives.

1. Adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Multipurpose Construction Adhesive: Formulation complying with ASTM D 3498 that is recommended for indicated use by adhesive manufacturer.

1. Adhesive shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FABRICATION

A. Back out or kerf backs of the following members except those with ends exposed in finished work:

1. Interior standing and running trim except shoe and crown molds.

B. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch (1.5-mm) radius and edges of lumber 1 inch (25 mm) or more in nominal thickness to 1/8-inch (3-mm) radius.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, too small to fabricate with proper jointing arrangements, or with defective surfaces, sizes, or patterns.

B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
2. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
3. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining interior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.
4. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.4 STANDING AND RUNNING TRIM INSTALLATION

A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long, except where necessary. Stagger joints in adjacent and related standing and running trim. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.

1. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
2. Install trim after gypsum-board joint finishing operations are completed.
3. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

3.5 ORNAMENTAL COLUMN INSTALLATION

A. Install columns to comply with manufacturer's written instructions. Comply with requirements below unless manufacturer's written instructions state otherwise.

B. Lay out column locations on ceiling and plumb down to locate column locations at floor.

C. Set plinths in location, shim as required to temporarily level, and scribe and trim as required so that tops of plinths will sit level without use of shims. Seal cut surfaces with wood sealer or primer and fasten plinths to floor using pins or fasteners as recommended by manufacturer.

D. Set columns in location, shim as required to temporarily plumb, and scribe and trim as required so that columns will sit plumb without shims.

E. Scribe and trim tops of columns to fit to ceiling.

F. Seal ends of columns with wood sealer or primer.

G. Install column caps on columns and fasten to columns.

H. Secure columns in place at top and bottom with fasteners recommended by manufacturer.

3.6 ADJUSTING

A. Replace interior finish carpentry that is damaged or does not comply with requirements. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.7 CLEANING

A. Clean interior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes, if any.

3.8 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062023

SECTION 071113 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cold-applied, cut-back-asphalt dampproofing.

B. Related Requirements:

1. Division 03 Section "Cast-in-Place Concrete" for bituminous vapor retarders.
2. Division 04 Section "Unit Masonry" for mortar parge coat on masonry surfaces.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.2: For dampproofing, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For dampproofing, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.4 FIELD CONDITIONS

A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.

B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide auxiliary materials recommended in writing by manufacturer of primary materials.

B. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise required.

2.2 COLD-APPLIED, CUT-BACK-ASPHALT DAMPPROOFING

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. APOC, Inc.; a division of Gardner-Gibson.
2. BASF Construction Chemicals - Building Systems; Sonneborn Brand Products.
3. Brewer Company (The).
4. ChemMasters, Inc.
5. Euclid Chemical Company (The); an RPM company.
6. Henry Company.
7. Karnak Corporation.
8. Koppers Inc.
9. Malarkey Roofing Products.
10. Meadows, W. R., Inc.

B. Trowel Coats: ASTM D 4586, Type I, Class 1, fibered.

C. Brush and Spray Coats: ASTM D 4479, Type I, fibered.

D. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Low-Emitting Materials: Dampproofing shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.

B. Cut-Back-Asphalt Primer: ASTM D 41.

C. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.

1. Primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.

E. Patching Compound: Asbestos-free fibered mastic of type recommended in writing by dampproofing manufacturer.

F. Protection Course: Smooth-surfaced roll roofing complying with ASTM D 6380, Class S, Type III.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions with Applicator present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of bituminous dampproofing work.

1. Test for surface moisture according to ASTM D 4263.

B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

B. Clean substrates of projections and substances detrimental to the dampproofing work; fill voids, seal joints, and remove bond breakers if any, as recommended in writing by prime material manufacturer.

C. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections; cover with asphalt-coated glass fabric.

3.3 APPLICATION, GENERAL

A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless more stringent requirements are indicated.

1. Apply dampproofing to provide continuous plane of protection.
2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.

B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches (150 mm) over outside face of footing.

1. Extend dampproofing 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

3.4 COLD-APPLIED, CUT-BACK-ASPHALT DAMPPROOFING

A. Concrete Foundations and Parged Masonry Foundation Walls: Apply two brush or spray coats at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat.

B. Unparged Masonry Foundation Walls: Apply primer and two brush or spray coats at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat.

3.5 INSTALLATION OF PROTECTION COURSE

A. Where indicated, install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.

1. Support protection course over cured coating with spot application of adhesive type recommended in writing by protection-board manufacturer.
2. Install protection course within 24 hours of installation of dampproofing (while coating is tacky) to ensure adhesion.

3.6 CLEANING

A. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071113

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Foam-plastic board insulation.
2. Glass-fiber blanket insulation.
3. Vapor retarders.

B. Related Sections:

1. Division 04 Section "Unit Masonry" for insulation installed in masonry cells.
2. Division 07 Section(s) Ethylene-Propylene-Diene-Monomer (EPDM) Roofing" for insulation specified as part of roofing construction.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

B. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. DiversiFoam Products.
b. Dow Chemical Company (The).
c. Owens Corning.
d. Pactiv Building Products.

2. Type IV, 25 psi (173 kPa).

B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

2.2 GLASS-FIBER BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. CertainTeed Corporation.
2. Guardian Building Products, Inc.
3. Johns Manville.
4. Knauf Insulation.
5. Owens Corning.

B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

C. Polypropylene-Scrim-Kraft-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type II (non-reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier).

D. Kraft-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type II (non-reflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).

E. Reinforced-Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

F. Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class B (faced surface with a flame-propagation resistance of 0.12 W/sq. cm); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

G. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide cross ventilation between insulated attic spaces and vented eaves.

H. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:

1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.3 VAPOR RETARDERS

A. Polyethylene Vapor Retarders: ASTM D 4397, 6 mils (0.15 mm) thick, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).

B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

D. Single-Component Nonsag Urethane Sealant: ASTM C 920, Type I, Grade NS, Class 25, Use NT related to exposure, and Use O related to vapor-barrier-related substrates.

E. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.

2.4 INSULATION FASTENERS

A. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. AGM Industries, Inc.; TACTOO Adhesive.
b. Gemco; Tuff Bond Hanger Adhesive.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF BELOW-GRADE INSULATION

A. On vertical surfaces, set insulation units loosely laid according to manufacturer's written instructions.

   1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

   1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm in from exterior walls.

3.4 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

   1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
   2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
   3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
   4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
   5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

   1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
   2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.5 INSTALLATION OF INSULATION IN CEILINGS FOR SOUND ATTENUATION

A. Where glass-fiber blankets are indicated for sound attenuation above ceilings, install blanket insulation over entire ceiling area in thicknesses indicated. Extend insulation 48 inches (1219 mm) up either side of partitions.

3.6 INSTALLATION OF VAPOR RETARDERS

A. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs.

1. Fasten vapor retarders to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches (406 mm) o.c.
2. Before installing vapor retarders, apply urethane sealant to flanges of metal framing including runner tracks, metal studs, and framing around door and window openings. Seal overlapping joints in vapor retarders with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Seal butt joints with vapor-retarder tape. Locate all joints over framing members or other solid substrates.
3. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.

C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.7 PROTECTION

A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

3.8 INSULATION SCHEDULE

A. Insulation Type 1: Type IV extruded-polystyrene board insulation, for foundation walls and under concrete slab on grade.

B. Insulation Type 2: Paper faced, glass-fiber blanket insulation in exterior walls for thermal insulation.

C. Insulation Type 3: Paper faced, glass-fiber blanket insulation in bottom cord of roof trusses in addition for thermal insulation.

D. Insulation Type 4: Unfaced, glass-fiber blanket insulation in existing building attic area for thermal insulation.

E. Insulation Type 5: Unfaced glass-fiber blanket insulation in interior walls for sound attenuation insulation. Provide sound attenuation insulation in all interior cold-formed framed and gypsum board partitions.

F. Insulation Type 6: Unfaced, slag-wool-fiber/rock-wool-fiber blanket insulation for fire safing insulation.

G. Insulation Type 7: Spray foam insulation used for filling miscellaneous voids in construction.

END OF SECTION 072100

SECTION 072500 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Building wrap.
2. Flexible flashing.

B. Related Requirements:

1. Division 06 Section "Sheathing" for sheathing joint and penetration treatment.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER

A. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Chemical Company (The); Styrofoam Weathermate Plus Brand Housewrap.
b. DuPont (E. I. du Pont de Nemours and Company); Tyvek CommercialWrap.
c. Ludlow Coated Products; Barricade Building Wrap.
d. Pactiv, Inc.; GreenGuard Ultra Wrap.
e. Raven Industries Inc.; Fortress Pro Weather Protective Barrier.
f. Reemay, Inc.; Typar HouseWrap.

2. Water-Vapor Permeance: Not less than 50 g through 1 sq. m of surface in 24 hours per ASTM E 96/E 96M, Desiccant Method (Procedure A).
3. Air Permeance: Not more than 0.004 cfm/sq. ft. at 0.3-inch wg (0.02 L/s x sq. m at 75 Pa) when tested according to ASTM E 2178.
4. Allowable UV Exposure Time: Not less than three months.

B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.2 MISCELLANEOUS MATERIALS

A. Flexible Flashing: As recommended by membrane manufacturer.

B. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.

C. Nails and Staples: ASTM F 1667.

PART 3 - EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.

B. Cover sheathing with water-resistive barrier as follows:

1. Cut back barrier 1/2 inch (13 mm) on each side of the break in supporting members at expansion- or control-joint locations.
2. Apply barrier to cover vertical flashing with a minimum 4-inch (100-mm) overlap unless otherwise indicated.

C. Building Wrap: Comply with manufacturer's written instructions.

1. Seal seams, edges, fasteners, and penetrations with tape.
2. Extend into jambs of openings and seal corners with tape.

3.2 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.

1. Prime substrates as recommended by flashing manufacturer.
2. Lap seams and junctures with other materials at least 4 inches (100 mm) except that at flashing flanges of other construction, laps need not exceed flange width.
3. Lap flashing over water-resistive barrier at bottom and sides of openings.
4. Lap water-resistive barrier over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION 072500

SECTION 074113 - METAL ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Standing-seam metal roof panels.
2. Vinyl soffit panels.

B. Related Sections:

1. Division 05 Section "Steel Decking" for steel roof deck supporting metal roof panels.
2. Division 05 Section "Cold-Formed Metal Framing" for cold-formed metal framing supporting metal roof panels.
3. Division 07 Section "Metal Wall Panels" for factory-formed metal soffit panels.
4. Division 07 Section "Sheet Metal Flashing and Trim" for field-formed fasciae, copings, flashings, roof drainage systems, and other sheet metal work not part of metal roof panel assemblies.
5. Division 07 Section "Joint Sealants" for field-applied sealants not otherwise specified in this Section.

1.3 DEFINITIONS

A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight roofing system.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Metal roof panels shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Design metal roof panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of roof area when tested according to ASTM E 1680 at the following test-pressure difference:

1. Test-Pressure Difference: Positive and negative 1.57 lbf/sq. ft. (75 Pa).
2. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. (720 Pa) and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.
3. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift-pressure difference.

D. Water Penetration: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:

1. Test-Pressure Difference: 20 percent of positive design wind pressure, but not less than 6.24 lbf/sq. ft. (300 Pa) and not more than 12.0 lbf/sq. ft. (575 Pa.
2. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. (720 Pa) and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.
3. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift-pressure difference.

E. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.

F. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.

G. Structural Performance: Provide metal roof panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:

1. Wind Loads: Determine loads based on the following minimum design wind pressures:

   a. Uniform pressure of 20 lbf/sq. ft. (957 Pa), acting inward or outward.
   b. Uniform pressure as indicated on Drawings.

2. Snow Loads: 35 lbf/sq. ft. (1676 Pa).
3. Deflection Limits: Metal roof panel assemblies shall withstand wind and snow loads with vertical deflections no greater than 1/240 of the span.

H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C, material surfaces.

I. Thermal Performance: Provide insulated metal roof panel assemblies with thermal-resistance value (R-value) indicated when tested according to ASTM C 518.

J. Energy Performance: Provide roof panels that are listed on the U.S. Department of Energy's ENERGY STAR Roof Products Qualified Product List for low-slope roof products.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of roof panel and accessory.

B. LEED Submittals:

1. Product Data for Credit MR 4: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating cost for each product having recycled content.

C. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, side-seam and endlap joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.

1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches (1:10):

a. Flashing and trim.
b. Roof curbs.
c. Snow guards.

D. Samples for Initial Selection: For each type of metal roof panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Metal Roof and Soffit Panels: 12 inches (300 mm) long by actual panel width. Include fasteners, closures, and other metal roof panel accessories.
2. Trim and Closures: 12 inches (300 mm) long. Include fasteners and other exposed accessories.
3. Accessories: 12-inch- (300-mm-) long Samples for each type of accessory.

F. Delegated-Design Submittal: For metal roof panel assembly indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Snow Retention System Calculations: Include calculation of number and location of snow guards based on snow load, roof slope, panel length and finish, and seam type and spacing.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, on which the following are shown and coordinated with each other, based on input from installers of the items involved:

1. Roof panels and attachments.
2. Purlins and rafters.
3. Roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, snow guards, and items mounted on roof curbs.

B. Manufacturer Certificates: Signed by manufacturer certifying that roof panels comply with energy performance requirements specified in "Performance Requirements" Article.

1. Submit evidence of meeting performance requirements.

C. Qualification Data: For qualified Installer.

D. Material Certificates: For thermal insulation and vapor retarders, from manufacturer.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

F. Field quality-control reports.

G. Warranties: Samples of special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal roof panels to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

C. Source Limitations: Obtain each type of metal roof panels from single source from single manufacturer.

D. Surface-Burning Characteristics: Provide metal roof panels having insulation core material with the following surface-burning characteristics as determined by testing identical products

according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

E. Fire-Resistance Ratings: Where indicated, provide metal roof panels identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
2. Combustion Characteristics: ASTM E 136.

F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical roof eave, including fascia, and soffit as shown on Drawings; approximately four panels wide by full eave width, including insulation, underlayment, attachments, and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

G. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal roof panel Installer, metal roof panel manufacturer's representative, deck. Installer, and installers whose work interfaces with or affects metal roof panels including installers of roof accessories and roof-mounted equipment.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal roof panel installation, including manufacturer's written instructions.
4. Examine deck substrate conditions for compliance with requirements, including flatness and attachment to structural members.
5. Review structural loading limitations of deck during and after roofing.
6. Review flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
7. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
8. Review temporary protection requirements for metal roof panel assembly during and after installation.
9. Review roof observation and repair procedures after metal roof panel installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.

B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.

E. Protect foam-plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.10 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit metal roof panel work to be performed according to manufacturer's written instructions and warranty requirements.

B. Field Measurements: Verify actual dimensions of construction contiguous with metal roof panels by field measurements before fabrication.

1.11 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal roof panels with rain drainage work, flashing, trim, and construction of decks, parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.12 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace metal roof panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANEL MATERIALS

A. Metallic-Coated Steel Sheet: Restricted flatness steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Recycled Content of Steel Sheet: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **25** percent.
2. Surface: Smooth, flat finish.
3. Exposed Coil-Coated Finish:

a. 3-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

4. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

B. Panel Sealants:

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal roof panels and remain weathertight; and as recommended in writing by metal roof panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.2 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: 30 to 40 mils (0.76 to 1.0 mm) thick minimum, consisting of slip-resisting, polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D 1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Carlisle Coatings & Waterproofing Inc., Div. of Carlisle Companies Inc.; CCW WIP 300HT.
   b. Grace Construction Products; a unit of Grace, W. R. & Co.; Ultra.
   c. Henry Company; Blueskin PE200 HT.
   d. Metal-Fab Manufacturing, LLC; MetShield.
   e. Owens Corning; WeatherLock Metal High Temperature Underlayment.

B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.3 SUBSTRATE BOARDS

A. Perlite Board: ASTM C 728, 1 inch (25 mm) thick.

B. Substrate-Board Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FMG 4470, designed for fastening substrate board to substrate.

2.4 MISCELLANEOUS METAL FRAMING

A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, or coating with equivalent corrosion resistance unless otherwise indicated.

B. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.

2.5 MISCELLANEOUS MATERIALS

A. Panel Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal roof panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.6 STANDING-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
2. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1637.

B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels : Formed with vertical ribs at panel edges and flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and mechanically seaming panels together.

1. Basis-of-Design Product: It is the intent of this specification to provide metal roof panels that match, as close as possible, the existing standing seam metal roof system. There is no information of documents available for the existing roof system. The only information known is that it is an American Buildings Company (ABC) product and it appears to be

their Loc Seam system. The existing system is installed over a pre-engineered metal support system which is supported by the original flat roof structure. The new roof system it ts match the existing roof system in material and appearance. If an ABC product is not used, other manufacturer's that can provide a comparable product in material and appearance could include the following:

a. AEP-Span.
b. Architectural Building Components.
c. Architectural Metal Systems.
d. Architectural Roofing and Siding, Inc.
e. ATAS International, Inc.
f. Berridge Manufacturing Company.
g. Butler Manufacturing; a BlueScope Steel company.
h. CENTRIA Architectural Systems.
i. Copper Sales, Inc.
j. Dimensional Metals, Inc.
k. Englert, Inc.
l. Fabral.
m. Flexospan Steel Buildings, Inc.
n. Integris Metals.
o. MBCI; a division of NCI Building Systems, L. P.
p. McElroy Metal, Inc.
q. Merchant & Evans.
r. Metal-Fab Manufacturing, LLC.
s. Metal Sales Manufacturing Corporation.
t. Metecno-Morin; Division of Metecno Inc.
u. Petersen Aluminum Corporation.
v. Steelox Systems, L.L.C.
w. Ultra Seam Incorporated.
x. United Steel Deck Inc.; Subsidiary of Bouras Industries Inc.

2. Material: Zinc-coated (galvanized) steel sheet, 22 gage.

   a. Exterior Finish: 3-coat fluoropolymer.
   b. Color: Match existing.

3. Clips: Fixed.

   a. Material: 0.028-inch- (0.71-mm nominal thickness, zinc-coated (galvanized steel sheet.

4. Joint Type: Standing seam, match existing roof system.
5. Panel Coverage: 16", match existing roof system.
6. Panel Height: 2", match existing roof system.

2.7 VINYL SOFFIT PANELS

A. General: Provide factory-formed vinyl soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. V-Groove-Profile Soffit Panels: Perforated panels formed with vertical panel edges and flat pan between panel edges; with V-groove joint between panels.

1. Material: Match Existing.

   a. Exterior Finish: Match existing.
   b. Color: Match existing.

2. Panel Coverage: Match existing.
3. Panel Height: Match existing.

2.8 ACCESSORIES

A. Roof Panel Accessories: Provide components approved by roof panel manufacturer and as required for a complete metal roof panel assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
2. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
3. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

B. Flashing and Trim: Formed from same material as roof panels, prepainted with coil coating, minimum 0.018 inch (0.45 mm) thick. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.

C. Gutters: Formed from same material roof panels. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- (2400-mm-) long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches (900 mm) o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match existing.

D. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot- (3-m-) long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual". Finish downspouts to match gutters.

E. Roof Curbs: Fabricated from same material as roof panels, minimum 0.048 inch (1.2 mm thick; with bottom of skirt profiled to match roof panel profiles, and welded top box and integral full-length cricket. Fabricate curb subframing of minimum 0.0598-inch- (1.5-mm-) thick, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads, of size and height indicated. Finish roof curbs to match metal roof panels.

1. Insulate roof curb with 1-inch- (25-mm-) thick, rigid insulation.

2.9 SNOW GUARDS

A. Snow Guards: Prefabricated, noncorrosive units designed to be installed without penetrating metal roof panels, and complete with predrilled holes, clamps, or hooks for anchoring.

1. Surface-Mounted, Plastic, Stop-Type Snow Guards: Clear polycarbonate stops designed for attachment to pan surface of metal roof panels using construction adhesive, silicone or polyurethane sealant, or adhesive tape.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Berger Bros. Co.; RTCLSM.
2) Polar Blox; Universal Snow Guard.
3) SNOBLOX; Snojax II.
4) Sno-Gem, Inc.; Sno-Gem Original.

2.10 FABRICATION

A. Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Fabricate metal roof panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weathertight and minimize noise from movements within panel assembly.

D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. End Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. End Seams for Other Than Aluminum: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA's "Architectural Sheet Metal Manual" or by metal roof panel manufacturer for application, but not less than thickness of metal being secured.

2.11 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the Work.

B. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.

C. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

D. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.

E. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

B. Substrate Board: Install substrate boards over roof deck on entire roof surface. Attach with substrate-board fasteners.

1. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
2. Comply with UL requirements for fire-rated construction.

C. Miscellaneous Framing: Install subpurlins, eave angles, furring, and other miscellaneous roof panel support members and anchorage according to metal roof panel manufacturer's written instructions.

1. Soffit Framing: Wire tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

3.3 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

1. Roof perimeter for a distance up from eaves of 24 inches (600 mm beyond interior wall line.
2. Valleys, from lowest point to highest point, for a distance on each side of 18 inches (460 mm). Overlap ends of sheets not less than 6 inches (150 mm).
3. Rake edges for a distance of 18 inches (460 mm).
4. Hips and ridges for a distance on each side of 12 inches (300 mm).
5. Roof to wall intersections for a distance from wall of 18 inches (460 mm.
6. Around dormers, chimneys, skylights, and other penetrating elements for a distance from element of 18 inches (460 mm).

B. Apply slip sheet over underlayment before installing metal roof panels.

C. Install flashings to cover underlayment to comply with requirements specified in Division 07 Section "Sheet Metal Flashing and Trim."

3.4 METAL ROOF PANEL INSTALLATION, GENERAL

A. Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.

B. Thermal Movement. Rigidly fasten metal roof panels to structure at one and only one location for each panel. Allow remainder of panel to move freely for thermal expansion and contraction. Predrill panels for fasteners.

1. Point of Fixity: Fasten each panel along a single line of fixing located at eave, ridge, center of panel length.
2. Avoid attaching accessories through roof panels in a manner that will inhibit thermal movement.

C. Install metal roof panels as follows:

1. Commence metal roof panel installation and install minimum of 300 sq. ft. (27.8 sq. m in presence of factory-authorized representative.
2. Field cutting of metal panels by torch is not permitted.
3. Install panels perpendicular to purlins.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Provide metal closures at rake edges, rake walls and each side of ridge and hip caps.
6. Flash and seal metal roof panels with weather closures at eaves, rakes, and perimeter of all openings.
7. Install ridge and hip caps as metal roof panel work proceeds.
8. End Splices: Locate panel end splices over, but not attached to, structural supports. Stagger panel end splices to avoid a four-panel splice condition.
9. Install metal flashing to allow moisture to run over and off metal roof panels.

D. Fasteners:

1. Steel Roof Panels: Use stainless-steel fasteners for surfaces exposed to the exterior and galvanized-steel fasteners for surfaces exposed to the interior.

E. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

F. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

1. Coat back side of roof panels with bituminous coating where roof panels will contact wood, ferrous metal, or cementitious construction.

G. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.

1. Seal metal roof panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal roof panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

3.5 METAL ROOF PANEL INSTALLATION

A. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
4. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.

3.6 VINYL SOFFIT PANEL INSTALLATION

A. In addition to complying with requirements in "Metal Roof Panel Installation, General" Article, install soffit panels to comply with requirements in this article.

B. Vinyl Soffit Panels: Provide soffit panels full width of soffits. Install panels perpendicular to support framing.

1. Flash and seal panels with weather closures where metal soffit panels meet walls and at perimeter of all openings.

C. Metal Fascia Panels: Align bottom of panels and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.7 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

C. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches (914 mm) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

D. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.
2. Connect downspouts to underground drainage system indicated.

E. Roof Curbs: Install curbs at locations indicated on Drawings. Install flashing around bases where they meet metal roof panels.

F. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.8 SNOW GUARD INSTALLATION

A. Stop-Type Snow Guards: Attach snow guards to metal roof panels with adhesive, sealant, or adhesive tape, as recommended by manufacturer. Do not use fasteners that will penetrate metal roof panels.

1. Provide two rows of snow guards, at locations indicated on Drawings, spaced 12” apart, beginning 12”up from gutter, with each snow guard centered between panel ribs.

3.9 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.10 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where inspections indicate that they do not comply with specified requirements.

C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113

SECTION 074219 - METAL PLATE WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes metal plate wall panels.

B. Related Sections:

1. Division 05 Section "Cold-Formed Metal Framing" for cold-formed metal framing supporting metal wall panels.
2. Division 07 Section "Sheet Metal Flashing and Trim" for field-formed flashings and other sheet metal work not part of metal wall panel assemblies.

1.3 DEFINITION

A. Metal Plate Wall Panel Assembly: Metal plate wall panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weathertight wall system.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Metal plate wall panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Design metal plate wall panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of wall area when tested according to ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).

D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

E. Water Penetration under Dynamic Pressure: No evidence of water leakage when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq. ft. (300 Pa) and not more than 12 lbf/sq. ft. (575 Pa).

1. Water Leakage: As defined according to AAMA 501.1.
2. Water Leakage: Uncontrolled water infiltrating the system or appearing on system's normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained back to the exterior and cannot damage adjacent materials or finishes is not water leakage.

F. Structural Performance: Provide metal plate wall panel assemblies capable of withstanding the effects of the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:

1. Wind Loads: Determine loads based on the following minimum design wind pressures:

a. Uniform pressure of 30 lbf/sq. ft. (1436 Pa), acting inward or outward.
b. Uniform pressure as indicated on Drawings.

2. Deflection Limits: Metal plate wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/180 of the span.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C, material surfaces.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal plate wall panel and accessory.

B. Shop Drawings: Show fabrication and installation layouts of metal plate wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish among factory-, shop-, and field-assembled work.

1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches (1:10):

   a. Flashing and trim.
   b. Anchorage systems.

C. Samples for Initial Selection: For each type of metal plate wall panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.
2. Include manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each sealant exposed to view.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Metal Plate Wall Panels: 12 inches (300 mm) long by actual panel width. Include fasteners, closures, and other panel accessories.
2. Trim and Closures: 12 inches (300 mm) long. Include fasteners and other exposed accessories.
3. Accessories: 12-inch- (300-mm-) long Samples for each type of accessory.
4. Exposed Sealants: For each type and color of joint sealant required. Install joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of metal plate wall panels adjacent to joint sealants.

E. Delegated-Design Submittal: For metal plate wall panel assembly indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Exterior elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Metal plate wall panels and attachments.
2. Penetrations of wall by pipes and utilities.

B. Qualification Data: For Installer and testing agency.

C. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

E. Field quality-control reports.

F. Warranties: Sample of special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal plate wall panels to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

C. Source Limitations: Obtain each type of metal plate wall panel from single source from single manufacturer.

D. Preconstruction Compatibility and Adhesion Testing: Submit samples of materials that will contact joint sealants to joint-sealant manufacturers for testing indicated below:

1. Use manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

   a. Perform tests under environmental conditions replicating those that will exist during installation.

2. Submit no fewer than nine pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule enough time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.

E. Fire-Resistance Ratings: Where indicated, provide metal plate wall panels identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall panel as shown on Drawings; approximately one bay wide by one story high by full thickness, including insulation, supports, attachments, and accessories. Include four-way joint.
2. Conduct water-spray test of mockup of metal plate wall panel assembly, testing for water penetration according to AAMA 501.2.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

G. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal plate wall panel Installer, metal plate wall panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects panels including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal plate wall panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal plate wall panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal plate wall panel assembly during and after installation.
8. Review metal plate wall panel observation and repair procedures after installation.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal plate wall panels, and other manufactured items so as not to be damaged or deformed. Package panels for protection during transportation and handling.

B. Unload, store, and erect metal plate wall panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal plate wall panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store panels to ensure dryness, with positive slope for drainage of water. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal plate wall panel for period of installation.

E. Protect foam-plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.10 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal plate wall panels to be performed according to manufacturer's written instructions and warranty requirements.

B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal plate wall panel fabrication and indicate measurements on Shop Drawings.

1.11 COORDINATION

A. Coordinate metal plate wall panel assemblies with rain drainage work, flashing, trim, and construction of studs, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.12 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal plate wall panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures, including rupturing, cracking, or puncturing.
   b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal plate wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANEL MATERIALS

A. Aluminum Plate: ASTM B 209 (ASTM B 209M). Alloy and temper as recommended by manufacturer for application.

B. Panel Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal plate wall panels and remain weathertight; and as recommended in writing by panel manufacturer.

2.2 MISCELLANEOUS METAL FRAMING

A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, or coating with equivalent corrosion resistance unless otherwise indicated.

B. Subgirts: Manufacturer's standard C- or Z-shaped sections, 0.064-inch (1.63-mm) nominal thickness.

C. Zee Clips: 0.079-inch (2.01-mm) nominal thickness.

D. Base or Sill Angles: 0.079-inch (2.01-mm) nominal thickness.

E. Hat-Shaped, Rigid Furring Channels:

1. Nominal Thickness: 0.025 inch (0.64 mm).
2. Depth: 7/8 inch (22 mm).

F. Cold-Rolled Furring Channels: Minimum 1/2-inch- (13-mm-) wide flange.

1. Nominal Thickness: 0.064 inch (1.63 mm).
2. Depth: 3/4 inch (19 mm).
3. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with nominal thickness of 0.040 inch (1.02 mm).
4. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.57-mm-) diameter wire, or double strand of 0.048-inch- (1.22-mm-) diameter wire.

G. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.

2.3 MISCELLANEOUS MATERIALS

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for type of use and finish indicated.

B. Panel Fasteners: Self-tapping screws; bolts and nuts; self-locking rivets and bolts; end-welded studs; and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

2.4 METAL PLATE WALL PANELS

A. Metal Plate Wall Panels: Provide factory-formed, metal plate wall panels fabricated from single sheets of metal formed into profile for installation method indicated. Include attachment system components, panel stiffeners, and accessories required for weathertight system.

1. Material: Match existing.
2. Panel Depth: Match existing.
3. Exterior Finish: Color anodized.

    a. Color: Match existing.

B. Attachment System Components: Formed from extruded aluminum.

2.5 ACCESSORIES

A. Metal Plate Wall Panel Accessories: Provide components required for a complete metal plate wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of panels unless otherwise indicated.

B. Flashing and Trim: Same material, finish, and color as adjacent metal plate wall panels, minimum 0.030 inch (0.76 mm) thick unless otherwise indicated.

2.6 FABRICATION

A. General: Fabricate and finish metal plate wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Fabricate metal plate wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.

C. Metal Plate Wall Panels: Fabricate panels with panel stiffeners as required to comply with deflection limits. Weld and grind panel corners smooth. Fabricate panels to the following dimensional tolerances:

1. Length and Width: Plus or minus 0.032 inch (0.81 mm) up to 48 inches (1219 mm); 0.064 inch (1.63 mm) more than 48 inches (1219 mm).
2. Diagonal: Plus or minus 0.1875 inch (4.76 mm).
3. Panel Bow: Not more than 0.2 percent of panel width or length up to 0.1875 inch (4.76 mm) maximum.
4. Thickness: Plus or minus 0.008 inch (0.2 mm).
5. Squareness: 0.1875-inch (4.76-mm) difference between diagonal measurements.
6. Camber: 0.032 inch (0.81 mm).

D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal plate wall panel manufacturer.

   a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal plate wall panel manufacturer for application, but not less than thickness of metal being secured.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable

if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, match existing.

B. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal plate wall panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal plate wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal plate wall panel manufacturer.
3. Verify that weather-resistant sheathing paper has been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal plate wall panels to verify actual locations of penetrations relative to seam locations of panels before installation.

C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous metal plate wall panel support members and anchorage according to ASTM C 754 and panel manufacturer's written instructions.

3.3 METAL PLATE WALL PANEL INSTALLATION

A. General: Install metal plate wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts unless otherwise indicated. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Commence metal plate wall panel installation and install minimum of 300 sq. ft. (27.8 sq. m) in presence of factory-authorized representative.
2. Shim or otherwise plumb substrates receiving metal plate wall panels.
3. Flash and seal metal plate wall panels with weather closures at perimeter of all openings. Do not begin installation until weather barrier and flashings that will be concealed by panels are installed.
4. Install flashing and trim as metal plate wall panel work proceeds.
5. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
6. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.

B. Fasteners:

1. Aluminum Plate Wall Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior and aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal plate wall panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall plate panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by panel manufacturer.

1. Seal metal plate wall panel end laps with double beads of sealant, full width of panel. Seal side joints where recommended by panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

E. Attachment System, General: Install attachment system required to support metal plate wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.

1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.

F. Flange-Attachment Installation: Attach metal plate wall panels, formed with extended perimeter flanges, to supports at locations, spacings, and with fasteners recommended by manufacturer.

1. Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Division 07 Section "Joint Sealants."
2. Seal horizontal and vertical joints between adjacent panels with manufacturer's standard gaskets.

G. Clip Installation: Attach panel clips to supports at locations, spacings, and with fasteners recommended by manufacturer. Attach flanges of metal plate wall panels to panel clips, as recommended by manufacturer.

1. Seal horizontal and vertical joints between adjacent metal plate wall panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Division 07 Section "Joint Sealants."
2. Seal horizontal and vertical joints between adjacent metal plate wall panels with manufacturer's standard gaskets.

H. Subgirt-and-Spline Installation: Provide manufacturer's standard subgirts and splines that provide support and complete secondary drainage system, draining to the exterior at horizontal joints. Install support system at locations, spacings, and with fasteners recommended by manufacturer. Attach metal plate wall panels by interlocking perimeter extrusions attached to panels with subgirts and splines. Fully engage integral subgirt-and-spline gaskets and leave horizontal and vertical joints with open reveal. Terminate edge of panels flush with perimeter extrusions.

1. Install metal plate wall panels to allow individual panels to be installed and removed without disturbing adjacent panels.
2. Do not apply sealants to joints unless otherwise indicated on Drawings.

I. Track-Support Installation: Provide manufacturer's standard horizontal tracks and vertical that provide support and complete secondary drainage system, draining to the exterior at horizontal joints through drain tube. Install support system at locations, spacings, and with fasteners recommended by manufacturer. Attach metal plate wall panels to tracks by interlocking panel edges with manufacturer's standard "T" clips.

1. Install metal plate wall panels to allow individual panels to be installed and removed without disturbing adjacent panels.
2. Seal horizontal and vertical joints between adjacent metal plate wall panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Division 07 Section "Joint Sealants."

J. Rail-Support Installation: Provide manufacturer's standard interlocking rails that provide support and complete secondary drainage system, draining to the exterior at horizontal joints. Install rails at locations, spacings, and with fasteners recommended by manufacturer. Attach metal plate wall panels by overlapping and interlocking support rails with perimeter rails attached to panels. Apply sealant, foam sealant, and tape sealant at locations recommended by manufacturer. Leave horizontal and vertical joints with open reveal.

1. Install metal plate wall panels to allow individual panels to be installed and removed without disturbing adjacent panels.
2. Install backer plates before installing support rails.
3. Do not apply sealants to joints unless otherwise indicated on Drawings.

3.4 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal plate wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.5 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal plate wall panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), nonaccumulative, on level, plumb, and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Water Penetration: Test areas of installed system indicated on Drawings for compliance with system performance requirements according to ASTM E 1105 at minimum differential pressure of 20 percent of inward-acting, wind-load design pressure as defined by SEI/ASCE 7, but not less than 6.24 lbf/sq. ft. (300 Pa).

C. Water-Spray Test: After completing the installation of 75-foot- (23-m-) by-2-story minimum area of metal plate wall panel assembly, test assembly for water penetration according to AAMA 501.2 in a 2-bay area directed by Architect.

D. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust completed metal plate wall panel installation, including accessories.

E. Metal plate wall panels will be considered defective if they do not pass tests and inspections.

F. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

G. Prepare test and inspection reports.

3.7 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal plate wall panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal plate wall panel installation, clean finished surfaces as recommended by panel manufacturer. Maintain in a clean condition during construction.

B. After metal plate wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal plate wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074219

SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Adhered EPDM membrane roofing system.
2. Vapor retarder.
3. Roof insulation.

B. Section includes the installation of acoustical roof deck rib insulation strips furnished under Division 05 Section "Steel Decking."

C. Related Sections:

1. Division 05 Section "Steel Decking" for furnishing acoustical deck rib insulation.
2. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
3. Division 07 Section "Thermal Insulation" for insulation beneath the roof deck.
4. Division 07 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counterflashings.
5. Division 07 Section "Manufactured Roof Expansion Joints" for proprietary manufactured roof expansion-joint assemblies.
6. Division 07 Section "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
7. Division 22 Section "Storm Drainage Piping Specialties" for roof drains.

1.3 DEFINITIONS

A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to

defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.

1. Field-of-Roof Uplift Pressure: 45 lbf/sq. ft. (kPa/sq. m)>.

D. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals' markings.

1. Fire/Windstorm Classification: Class 1A-90.
2. Hail Resistance: MH.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1" Subparagraph applies to LEED-NC and LEED-CS; coordinate with requirements selected in Part 2 for adhesives and sealants.
2. Product Data for Credit IEQ 4.1: For adhesives and sealants used inside the weatherproofing system, documentation including printed statement of VOC content.

C. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacings and patterns for mechanically fastened membrane roofing.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

D. Samples for Verification: For the following products, in manufacturer's standard sizes:

1. Sheet roofing, of color specified, including T-shaped side and end lap seam.
2. Roof insulation.
3. Termination bars.
4. Battens.

5. Six insulation fasteners of each type, length, and finish.
6. Six roof cover fasteners of each type, length, and finish.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and manufacturer.

B. Manufacturer Certificate: Signed by roofing manufacturer certifying that membrane roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of complying with performance requirements.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.

D. Research/Evaluation Reports: For components of membrane roofing system, from the ICC-ES.

E. Field quality-control reports.

F. Warranties: Sample of special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For membrane roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for membrane roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

C. Source Limitations: Obtain components including roof insulation and fasteners for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.

D. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

E. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

F. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements for deck substrate conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

G. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.10 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners,] cover boards, substrate board, roofing accessories, and other components of membrane roofing system.
2. Warranty Period: 15 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 EPDM MEMBRANE ROOFING

A. EPDM: ASTM D 4637, Type I, non-reinforced, uniform, flexible EPDM sheet.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Carlisle SynTec Incorporated.
b. ERSystems.
c. Firestone Building Products.
d. GAF Materials Corporation.
e. GenFlex Roofing Systems.
f. International Diamond Systems.
g. Johns Manville.
h. Mule-Hide Products Co., Inc.
i. Protective Coatings, Inc.
j. Roofing Products International, Inc.
k. StaFast Building Products.
l. Versico Incorporated.

2. Thickness: 60 mils (1.5 mm), nominal.
3. Exposed Face Color: Black.

2.2 AUXILIARY MEMBRANE ROOFING MATERIALS

A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. Plastic Foam Adhesives: 50 g/L.
b. Gypsum Board and Panel Adhesives: 50 g/L.
c. Multipurpose Construction Adhesives: 70 g/L.
d. Fiberglass Adhesives: 80 g/L.
e. Single-Ply Roof Membrane Adhesives: 250 g/L.
f. Single-Ply Roof Membrane Sealants: 450 g/L.
g. Nonmembrane Roof Sealants: 300 g/L.
h. Sealant Primers for Nonporous Substrates: 250 g/L.
i. Sealant Primers for Porous Substrates: 775 g/L.

j. Other Adhesives and Sealants: 250 g/L.

3. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Sheet Flashing: 60-mil- (1.5-mm-) thick EPDM, partially cured or cured, according to application.

C. Protection Sheet: Epichlorohydrin or neoprene non-reinforced flexible sheet, 55- to 60-mil- (1.4- to 1.5-mm-) thick, recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil.

D. Bonding Adhesive: Manufacturer's standard.

E. Seaming Material: Manufacturer's standard, synthetic-rubber polymer primer and 3-inch- (75-mm-) wide minimum, butyl splice tape with release film.

F. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.

G. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

H. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

I. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), prepunched.

J. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to roofing system manufacturer.

K. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

2.3 SUBSTRATE BOARDS

A. Substrate Board: ASTM C 728, perlite board, 3/4 inch (19 mm) thick, seal coated.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate panel to roof deck.

2.4 VAPOR RETARDER

A. Polyethylene Film: ASTM D 4397, 6 mils (0.15 mm) thick, minimum, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).

1. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
2. Adhesive: Manufacturer's standard lap adhesive, FM Approvals approved for vapor-retarder application.

B. Laminated Sheet: Kraft paper, two layers, laminated with asphalt and edge reinforced with woven fiberglass yarn with maximum permeance rating of 0.50 perm (29 ng/Pa x s x sq. m) and with manufacturer's standard adhesive.

C. Glass-Fiber Felts: ASTM D 2178, Type IV, asphalt impregnated.

2.5 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by EPDM membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.

B. Composite Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2 with factory-applied facing board on one major surface, as indicated below by type, and felt or glass-fiber mat facer on the other.

1. Type IV, cellulosic-fiber-insulation-board facer, Grade 2, 1/2 inch (13 mm) thick.

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.6 INSULATION ACCESSORIES

A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

C. Modified Asphaltic Insulation Adhesive: Insulation manufacturer's recommended modified asphalt, asbestos-free, cold-applied adhesive formulated to attach roof insulation to substrate or to another insulation layer.

D. Bead-Applied Insulation Adhesive: Insulation manufacturer's recommended bead-applied, low-rise, one- or multicomponent urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.

E. Full-Spread Applied Insulation Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.

F. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

2.7 ASPHALT MATERIALS

A. Roofing Asphalt: ASTM D 312, Type III or Type IV.

B. Asphalt Primer: ASTM D 41.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."
4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
6. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

D. Install acoustical roof deck rib insulation strips, specified in Division 05 Section "Steel Decking," according to acoustical roof deck manufacturer's written instructions, immediately before installation of overlying construction and to remain dry.

3.3 SUBSTRATE BOARD

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to membrane roofing system manufacturers' written instructions.

3.4 VAPOR-RETARDER INSTALLATION

A. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50 mm) and 6 inches (150 mm), respectively.

1. Continuously seal side and end laps with tape.

B. Laminate Sheet: Install laminate-sheet vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50 mm) and 6 inches (150 mm), respectively. Bond vapor retarder to substrate as follows:

1. Apply adhesive at rate recommended by vapor-retarder manufacturer. Seal laps with adhesive.
2. Apply ribbons of hot roofing asphalt at spacing, temperature, and rate recommended by vapor-retarder manufacturer. Seal laps with hot roofing asphalt.

C. Built-Up Vapor Retarder: Install two glass-fiber felt plies lapping each felt 19 inches (483 mm) over preceding felt. Embed each felt in a solid mopping of hot roofing asphalt. Glaze-coat completed surface with hot roofing asphalt. Apply hot roofing asphalt within plus or minus 25 deg F (14 deg C) of equiviscous temperature.

D. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

3.5 INSULATION INSTALLATION

A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:

1. Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m) and allow primer to dry.
2. Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
3. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
4. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

H. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together and fasten to roof deck.

1. Fasten cover boards according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.

3.6 ADHERED MEMBRANE ROOFING INSTALLATION

A. Adhere membrane roofing over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.

B. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.

C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.

E. Hot Roofing Asphalt: Apply a solid mopping of hot roofing asphalt to substrate at temperature and rate required by manufacturer and install fabric-backed membrane roofing. Do not apply to splice area of membrane roofing.

F. Fabric-Backed Membrane Adhesive: Apply to substrate at rate required by manufacturer and install fabric-backed membrane roofing.

G. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeters.

H. Apply membrane roofing with side laps shingled with slope of roof deck where possible.

I. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.

1. Apply a continuous bead of in-seam sealant before closing splice if required by membrane roofing system manufacturer.

J. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.

K. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

L. Spread sealant or mastic bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

M. Install membrane roofing and auxiliary materials to tie in to existing membrane roofing to maintain weather-tightness of transition.

N. Adhere protection sheet over membrane roofing at locations indicated.

3.7 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing agency to perform inspections.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

C. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

D. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.9 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.10 ROOFING INSTALLER'S WARRANTY

A. WHEREAS <**Insert name**> of <**Insert address**>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <**Insert name of Owner.**>
2. Address: <**Insert address.**>
3. Building Name/Type: <**Insert information.**>
4. Address: <**Insert address.**>
5. Area of Work: <**Insert information.**>
6. Acceptance Date: <**Insert date.**>
7. Warranty Period: <**Insert time.**>
8. Expiration Date: <**Insert date.**>

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

   a. Lightning;
   b. Peak gust wind speed exceeding 90 mph (m/sec);
   c. Fire;
   d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
   e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
   f. Vapor condensation on bottom of roofing; and
   g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this <**Insert day**> day of <**Insert month**>, <**Insert year**>.

1. Authorized Signature: <**Insert signature**>.
2. Name: <**Insert name**>.
3. Title: <**Insert title**>.

END OF SECTION 075323

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Manufactured Products:

   a. Manufactured through-wall flashing and counterflashing.
   b. Manufactured reglets and counterflashing.

2. Formed Products:

   a. Formed roof drainage sheet metal fabrications.
   b. Formed low-slope roof sheet metal fabrications.
   c. Formed steep-slope roof sheet metal fabrications.
   d. Formed wall sheet metal fabrications.
   e. Formed equipment support flashing.

B. Related Sections:

1. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
2. Division 07 Section "Ethylene-Propylene-Diene-Monomer (Epdm) Roofing" for installing sheet metal flashing and trim integral with membrane roofing.
3. Division 07 Section "Metal Roof Panels" for sheet metal flashing and trim integral with metal roof panels.
4. Division 07 Section "Roof Specialties" for manufactured roof specialties not part of sheet metal flashing and trim.
5. Division 07 Section "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
6. Division 07 Section "Expansion Control" for manufactured sheet metal expansion-joint covers.

1.3 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:

1. Wind Zone 1: For velocity pressures of 21 to 30 lbf/sq. ft. (1.00 to 1.44 kPa): 60-lbf/sq. ft. (2.87-kPa) perimeter uplift force, 90-lbf/sq. ft. (4.31-kPa) corner uplift force, and 30-lbf/sq. ft. (1.44-kPa) outward force.

C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C, material surfaces.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:

1. Identification of material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
4. Details of termination points and assemblies, including fixed points.
5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
7. Details of special conditions.
8. Details of connections to adjoining work.
9. Detail formed flashing and trim at a scale of not less than 1-1/2 inches per 12 inches (1:10).

C. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.
3. Accessories and Miscellaneous Materials: Full-size Sample.
4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified fabricator.

B. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

C. Copper Sheet Metal Standard: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical roof eave, including gutter, fascia, soffit, roofing, etc., approximately 6 feet long, including supporting construction cleats, seams, attachments, underlayment, and accessories.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

E. Preinstallation Conference: Conduct conference at Project site

1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
2. Review methods and procedures related to sheet metal flashing and trim.
3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
4. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing.
5. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.9 WARRANTY

A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.
2. Surface: Smooth, flat.
3. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

4. Color: Match Existing.
5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

2.2 UNDERLAYMENT MATERIALS

A. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.

B. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

C. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C).
2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C).
3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Carlisle Coatings & Waterproofing Inc.; CCW WIP 300HT.
b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
c. Henry Company; Blueskin PE200 HT.

d. Metal-Fab Manufacturing, LLC; MetShield.
e. Owens Corning; WeatherLock Metal High Temperature Underlayment.

D. Slip Sheet: Building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum, rosin sized.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.
3. Fasteners for Zinc Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.

C. Solder:

1. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

H. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Through-Wall Ribbed Sheet Metal Flashing: Manufacture through-wall sheet metal flashing for embedment in masonry with ribs at 3-inch (75-mm) intervals along length of flashing to provide an integral mortar bond.

1. Stainless Steel: 0.016 inch (0.40 mm) thick.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following]:

1) Cheney Flashing Company; Cheney Flashing (Dovetail).
2) Cheney Flashing Company; Cheney Flashing (Sawtooth).
3) Hohmann & Barnard, Inc.; STF Sawtooth Flashing.
4) Keystone Flashing Company, Inc.; Keystone Three-Way Interlocking Thruwall Flashing.
5) Sandell Manufacturing Company, Inc.; Pre-Formed Metal Flashing.

2.5 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.

E. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

G. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

H. Do not use graphite pencils to mark metal surfaces.

2.6 ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- (2400-mm-) long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters.

1. Gutter Style: Match Existing.
2. Expansion Joints: Match Existing.
3. Gutters with Girth up to 15 Inches (380 mm): Fabricate from the following materials:

   a. Aluminum: 0.032 inch (0.81 mm) thick.
   b. Galvanized Steel: 0.022 inch (0.56 mm) thick.
   c. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.

4. Gutters with Girth 16 to 20 Inches (410 to 510 mm): Fabricate from the following materials:

   a. Aluminum: 0.040 inch (1.02 mm) thick.
   b. Galvanized Steel: 0.028 inch (0.71 mm) thick.
   c. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

5. Gutters with Girth 21 to 25 Inches (530 to 640 mm): Fabricate from the following materials:

   a. Aluminum: 0.050 inch (1.27 mm) thick.
   b. Galvanized Steel: 0.034 inch (0.86 mm) thick.
   c. Aluminum-Zinc Alloy-Coated Steel: 0.034 inch (0.86 mm) thick.

6. Gutters with Girth 26 to 30 Inches (660 to 760 mm): Fabricate from the following materials:

    a. Aluminum: 0.063 inch (1.60 mm) thick.
    b. Galvanized Steel: 0.040 inch (1.02 mm) thick.
    c. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch (1.02 mm) thick.

7. Gutters with Girth 31 to 35 Inches (790 to 890 mm): Fabricate from the following materials:

    a. Galvanized Steel: 0.052 inch (1.32 mm) thick.
    b. Aluminum-Zinc Alloy-Coated Steel: 0.052 inch (1.32 mm) thick.

B. Downspouts: Fabricate rectangular downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.

1. Fabricated Hanger Style: Match Existing.
2. Manufactured Hanger Style: Match Existing.
3. Hanger Style: Match Existing.
4. Fabricate from the following materials:

    a. Aluminum: 0.024 inch (0.61 mm) thick.
    b. Galvanized Steel: 0.022 inch (0.56 mm) thick.
    c. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof-Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Furnish with 6-inch- (150-mm-) wide, joint cover plates.

1. Joint Style: Butt, with 12-inch- (300-mm-) wide, concealed backup plate.
2. Fabricate with scuppers spaced 10 feet (3 m) apart, of dimensions required with 4-inch- (100-mm-) wide flanges and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
3. Fabricate from the following materials:

    a. Aluminum: 0.050 inch (1.27 mm) thick.
    b. Galvanized Steel: 0.028 inch (0.71 mm) thick.
    c. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

B. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and interior leg. Miter corners, seal, and solder or weld watertight.

1. Coping Profile: As indicated on drawings.

2. Joint Style: Butt, with 12-inch- (300-mm-) wide, concealed backup plate.
3. Fabricate from the following materials:

a. Galvanized Steel: 0.040 inch (1.02 mm) thick.

C. Roof and Roof to Wall Transition, and Roof to Roof Edge Flashing (Gravel Stop) and Fascia Cap Transition, Expansion-Joint Cover: Fabricate from the following materials:

1. Galvanized Steel: 0.034 inch (0.86 mm thick.

D. Base Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch (0.71 mm thick.

E. Counterflashing: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch (0.56 mm) thick.

F. Flashing Receivers: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch (0.56 mm) thick.

G. Roof-Penetration Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch (0.71 mm thick.

2.8 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch (0.56 mm) thick.

B. Valley Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch (0.71 mm) thick.

C. Drip Edges: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch (0.56 mm) thick.

D. Eave, Rake, Ridge, and Hip Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch (0.56 mm) thick.

E. Counterflashing: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch (0.56 mm) thick.

F. Flashing Receivers: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch (0.56 mm) thick.

G. Roof-Penetration Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch (0.71 mm) thick.

2.9 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings. Form with 2-inch- (50-mm-) high, end dams where flashing is discontinuous. Fabricate from the following materials:

1. Stainless Steel: 0.016 inch (0.40 mm) thick.

B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.016 inch (0.40 mm) thick.

C. Wall Expansion-Joint Cover: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch (0.71 mm) thick.

2.10 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch (0.71 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. General: Install underlayment as indicated on Drawings.

B. Polyethylene Sheet: Install polyethylene sheet with adhesive for anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped and taped joints of not less than 2 inches (50 mm).

C. Felt Underlayment: Install felt underlayment with adhesive for temporary anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

D. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
5. Install sealant tape where indicated.
6. Torch cutting of sheet metal flashing and trim is not permitted.
7. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

1. Coat back side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints as shown and as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm), except reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not solder metallic-coated steel sheet.
2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
3. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
4. Copper Soldering: Tin edges of uncoated copper sheets using solder for copper.

3.4 ROOF DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets spaced not more than 36 inches (900 mm) apart. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Fasten gutter spacers to front and back of gutter.
2. Loosely lock straps to front gutter bead and anchor to roof deck.
3. Anchor and loosely lock back edge of gutter to continuous cleat.
4. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches (600 mm) apart.
5. Anchor gutter with spikes and ferrules spaced not more than 24 inches (600 mm apart.
6. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet (15.24 m) apart. Install expansion-joint caps.

C. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints.

1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c. in between.
2. Provide elbows at base of downspout to direct water away from building.
3. Connect downspouts to underground drainage system indicated.

D. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints a minimum of 4 inches (100 mm) in direction of water flow.

3.5 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at **staggered 3-inch (75-mm** centers.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.

1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch (600-mm) centers.
2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch (600-mm) centers.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with sealant. Secure in a waterproof manner by means of snap-in installation and sealant or lead wedges and sealant.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Through-Wall Flashing: Installation of through-wall flashing is specified in Division 04 Section "Unit Masonry."

C. Reglets: Installation of reglets is specified in Division 04 Section "Unit Masonry."

D. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

3.7 MISCELLANEOUS FLASHING INSTALLATION

A. Overhead-Piping Safety Pans: Suspend pans independent from structure above as indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

B. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.8 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.9 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.
4. Acoustical joint sealants.

B. Related Sections:

1. Division 04 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
2. Division 07 Section "Expansion Control" for building expansion joints.
3. Division 07 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
4. Division 08 Section "Glazing" for glazing sealants.
5. Division 09 Section "Gypsum Board" for sealing perimeter joints.
6. Division 09 Section "Tiling" for sealing tile joints.
7. Division 09 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters with acoustical sealant.
8. Division 32 Section "Concrete Paving Joint Sealants" for sealing joints in pavements, walkways, and curbing.

1.3 PRECONSTRUCTION TESTING

A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.

3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each application indicated below:

   a. Each kind of sealant and joint substrate indicated.

3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.

   a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

      1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.4 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.

C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

E. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and testing agency.

B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

C. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

E. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

F. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

G. Field-Adhesion Test Reports: For each sealant application tested.

H. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

E. Preinstallation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Low-Emitting Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

E. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

F. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

G. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

D. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant ES-1:

1. Products:

a. Pecora Corporation; 898.
b. Tremco; Tremsil 600 White.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.

a. Use O Joint Substrates: stainless steel, galvanized steel, vitreous china, and plastic laminate.

E. Multicomponent Nonsag Urethane Sealant ES-2:

1. Products:

a. Pecora Corporation; Dynatrol II.
b. Tremco; Dymeric 511.
c. Tremco; Vulkem 922.

2. Type and Grade: M (multicomponent) and NS (nonsag).
3. Class: 50.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

a. Use O Joint Substrates: aluminum coated with a high-performance coating galvanized steel brick concrete masonry units.

F. Multicomponent Pourable Urethane Sealant ES-3:

1. Products:

a. Pecora Corporation; Dynatrol II-SG.
b. Sika Corporation, Inc.; Sikaflex - 2c SL.
c. Sonneborn, Division of ChemRex Inc.; SL 2.

2. Type and Grade: M (multicomponent) and P (pourable).
3. Class: 25.
4. Uses Related to Exposure: T (traffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

a. Use O Joint Substrates: aluminum coated with a high-performance coating terrazzo tile.

G. Single-Component Neutral-Curing Silicone Sealant ES-4:

1. Products:
a. Dow Corning Corporation; 791.
b. Dow Corning Corporation; 795
c. GE Silicones; SilPruf NB SCS9000.
d. GE Silicones; UltraPruf II SCS2900.
e. Pecora Corporation; 895.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 50 100/50.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

a. Use O Joint Substrates: Coated glass aluminum coated with a high-performance coating.

6. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.

2.3 SOLVENT-RELEASE JOINT SEALANTS

A. Butyl-Rubber-Based Solvent-Release Joint Sealant SRS-1: Comply with ASTM C 1085.

1. Products:

a. Bostik Findley; Bostik 300.
b. Fuller, H. B. Company; SC-0296.
c. Fuller, H. B. Company; SC-0288.
d. Pecora Corporation; BC-158.
e. Polymeric Systems Inc.; PSI-301
f. Sonneborn, Division of ChemRex Inc.; Sonneborn Multi-Purpose Sealant.
g. Tremco; Tremco Butyl Sealant.

2.4 LATEX JOINT SEALANTS

A. Latex Sealant LS-1: Comply with ASTM C 834, Type P, Grade NF.

B. Products:

1. Bostik Findley; Chem-Calk 600.
2. Pecora Corporation; AC-20+.
3. Schnee-Morehead, Inc.; SM 8200.
4. Sonneborn, Division of ChemRex Inc.; Sonolac.
5. Tremco; Tremflex 834.

2.5 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints AS-1: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following:

1. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
2. Products:

a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

2.6 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.

d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

G. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:

1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch (10 mm). Hold edge of sealant bead 1/4 inch (6 mm) inside masking tape.
3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.

H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.

I. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

    a. Perform 5 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
    b. Perform 1 test for each 1000 feet (300 m) of joint length thereafter or 1 test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

    a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

    a. Whether sealants filled joint cavities and are free of voids.
    b. Whether sealant dimensions and configurations comply with specified requirements.
    c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application JS-1: Exterior vertical and horizontal nontraffic construction joints in cast-in-place concrete.

1. Joint Sealant: Multicomponent nonsag urethane sealant ES-2.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

B. Joint-Sealant Application JS-2: Exterior horizontal nontraffic and traffic isolation and contraction joints in cast-in-place concrete slabs.

1. Joint Sealant: multi-component pourable urethane sealant ES-3.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

C. Joint-Sealant Application JS-3: Exterior vertical control joints in unit masonry.

1. Joint Sealant: Multicomponent nonsag urethane sealant ES-2.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

D. Joint-Sealant Application JS-4: Structural glazing joints between glass and aluminum window framing.

1. Joint Sealant: Single component neutral curing sealant ES-4.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range

E. Joint-Sealant Application JS-5: Exterior perimeter joints between masonry and frames of doors windows and louvers.

1. Joint Sealant: Multicomponent nonsag urethane sealant ES-2.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

F. Joint-Sealant Application JS-6: Exterior vertical and horizontal non traffic joints between flashing components where limited sliding movement occurs, and between flashing and other components where limited sliding movement occurs.

1. Joint Sealant: Butyl-Rubber-Based Solvent-Release Joint Sealant SRS-1.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

G. Joint-Sealant Application JS-7: Vertical control and expansion joints on exposed interior surfaces of exterior walls.

1. Joint Sealant: Multicomponent nonsag urethane sealant ES-2.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

H. Joint-Sealant Application JS-8: Interior perimeter joints of exterior openings.

1. Joint Sealant: Multicomponent nonsag urethane sealant ES-2.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

I. Joint-Sealant Application JS-9: Interior joints between plumbing fixtures and adjoining walls, floors, and counters. Interior joints between toilet accessories and adjoining walls, floors and counters. Interior joints between casework and adjoining surfaces. Interior joints between food service equipment and adjoining surfaces. Interior joints between cut edges of resilient floor materials and hollow metal door frames and aluminum entrance systems.

1. Joint Sealant: Single-component mildew-resistant neutral-curing silicone sealant ES-1.
2. Joint-Sealant Color: White at plumbing fixtures and toilet accessories and adjoining surfaces, translucent between casework and food service equipment and adjoining surfaces and between resilient materials and adjacent door frames.

J. Joint-Sealant Application JS-10: Vertical joints on exposed surfaces of interior unit masonry walls and partitions.

1. Joint Sealant: Multicomponent nonsag urethane sealant ES-2.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

K. Joint-Sealant Application JS-11: Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.

1. Joint Sealant: Latex sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Related Sections:

1. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
2. Division 08 Section “Flush Wood Doors”.
3. Division 08 Section "Glazing" for glass view panels in hollow metal doors.
4. Division 08 Section "Door Hardware".
5. Division 08 Section "Access Control Hardware".
6. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

B. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. ANSI/BHMA A156.15 - Hardware Preparation in Steel Doors and Frames.
10. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
11. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
12. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.

13. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
14. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
15. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.

B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.

C. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of anchorages, joints, field splices, and connections.
6. Details of accessories.
7. Details of moldings, removable stops, and glazing.
8. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Verification:

1. Samples are only required by request of the architect and for manufactures that are not current members of the Steel Door Institute.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 (neutral pressure at 40” above sill) or UL 10C.

1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.

2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
3. Smoke Control Door Assemblies: Comply with NFPA 105.

    a. Smoke "S" Label: Doors to bear “S” label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.

E. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CECO Door Products.
2. Curries Company.
3. Steelcraft.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 STANDARD HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.

B. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, or one-piece polystyrene core, securely bonded to both faces.

a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

3. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
4. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
5. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Manufacturers Basis of Design:

1. Curries Company 707 Series.

2.4 ENERGY EFFICIENCY HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of design specified, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.

B. Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A924 A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model, ANSI/SDI A250.4 for physical performance level, and HMMA 867 for door construction.

1. Design: Flush panel.
2. Core Construction: Foamed in place polyurethane and steel stiffened laminated core with no stiffener face welds, in compliance with HMMA 867 “Laminated Core”.

a. Provide 22 gauge steel stiffeners at 6 inches on-center internally welded at 5" on-center to integral core assembly, foamed in place polyurethane core chemically bonded to all interior surfaces. No stiffener face welding is permitted.
b. Thermal properties to rate at a fully operable minimum U-Factor 0.29 and R-Value 3.4, including insulated door, thermal-break frame and threshold.

1) Kerf Type Frames: Thermal properties to rate at a fully operable minimum U-Factor 0.36 and R-Value 2.8, including insulated door, kerf type frame, and threshold.

3. Level/Model: Level 2 and Physical Performance Level A (Heavy Duty), Minimum 18 gauge (0.042 inch - 1.1-mm) thick steel, Model 2.
4. Vertical Edges: Vertical edges to be mechanically interlocked with hairline seam. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw

attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.

6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9".
7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Manufacturers Basis of Design:

1. Curries Company 777 Trio-E/Trio Series.

2.5 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames, with the exception of slip-on drywall types, with "closed and tight" miter seams continuously welded on face, finished smooth with no visible seam unless otherwise indicated.
3. Frames for Level 2 Steel Doors: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
4. Frames for Level 3 Steel Doors (up to 48 inches in width): Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.]
5. Frames for Level 3 Steel Doors (48 inches and up in width): Minimum 14 gauge (0.067-inch -1.7-mm) thick steel sheet.]
6. Frames for Wood Doors: Minimum 16 gauge (0.053-inch-1.3-mm-) thick steel sheet.
7. Frames for Borrowed Lights: Minimum 16 gauge (0.053-inch-1.3-mm-) thick steel sheet.
8. Manufacturers Basis of Design:

a. Curries Company M Series (Masonry Profile).

C. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.6 ENERGY EFFICIENCY HOLLOW METAL FRAMES

A. Weatherstripped Frames: Subject to the same compliance standards and requirements as standard hollow metal frames, provide where indicated weatherstripped profiles with 1/8" integral kerf formed into the frame soffit able to receive manufacturer's listed gasket material. Available for use in both masonry and drywall construction, with fire rating up to 3 hours complying with NFPA 105, UL 1784, and ASTM E-283 Test criteria.

1. Manufacturers Basis of Design:

    a. Curries Company - Weatherstripped WM Series.

2.7 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud Wall Type: Designed to engauge stud and not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.
4. Windstorm Opening Anchors: Types as tested and required for indicated wall types to meet specified wind load design criteria.
5. FEMA 361 Storm Shelter Anchors: Masonry T-shaped, wire masonry type, or existing opening type anchors.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.8 HOLLOW METAL PANELS

A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.9 LOUVERS

A. Metal Louvers: Door manufacturer's standard metal louvers unless otherwise indicated.

1. Blade Type: Vision proof inverted V or inverted Y.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less.

1. Manufacturers: Subject to compliance with requirements, provide door manufacturers standard louver to meet rating indicated.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

2.10 LIGHT OPENINGS AND GLAZING

A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator’s shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.

C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames

D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

E. Glazing: Comply with requirements in Division 08 Section "Glazing" and with the hollow metal door manufacturer's written instructions.

1. Factory Glazing: Factory install glazing in doors as indicated. Doors with factory installed glass to include all of the required glazing material.

2.11 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.12 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.

2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

    a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.

8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Two anchors per jamb up to 60 inches high.
        2) Three anchors per jamb from 60 to 90 inches high.
        3) Four anchors per jamb from 90 to 120 inches high.
        4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

1) Three anchors per jamb up to 60 inches high.
2) Four anchors per jamb from 60 to 90 inches high.
3) Five anchors per jamb from 90 to 96 inches high.
4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.

10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".

E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.13 STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.

b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS AND WOOD FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid core doors with wood veneer faces.
2. Factory finishing wood doors.

B. Related Sections:
1. Division 08 Section "Hollow Metal Doors and Frames" for wood doors in steel frames.
2. Division 08 Section "Glazing" for glass view panels in wood doors.
3. Division 08 Section "Door Hardware" for door hardware for flush wood doors and wood frames.
4. Division 08 Section "Access Control Hardware" for electromechanical hardware for flush wood doors and wood frames.

C. Standards and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A208.1 – Wood Particleboard.
2. Intertek Testing Service (ITS Warnock Hersey) - Certification Listings for Fire Doors.
3. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
4. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
5. UL 10C - Positive Pressure Fire Tests of Door Assemblies; UL 1784 - Standard for Air Leakage Tests of Door Assemblies.
6. Window and Door Manufacturers Association - WDMA I.S.1-A Architectural Wood Flush Doors.

1.3 SUBMITTALS

A. Product Data: For each type of door indicated. Include details of core and edge construction, louvers, trim for openings, and WDMA I.S.1-A or AWS classifications. Include factory finishing specifications.

B. LEED Submittals:

1. Certificates for Credit MR 6: Chain-of-custody certificates indicating that flush wood doors comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
2. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that product contains no urea formaldehyde.

C. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the wood door supplier in order to prepare the doors and frames to receive the finish hardware items.

D. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.
5. Indicate fire protection ratings for fire rated doors.

E. Samples for Initial Selection: For factory finished doors.

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.

2. Corner sections of doors, 8 by 10 inches, with door faces and edges representing actual materials to be used.

a. Provide samples for each species of veneer and solid lumber required.
b. Finish veneer faced door samples with same materials proposed for factory finished doors.

3. Frames for light openings, 6 inches long, for each material, type, and finish required.

F. Informational Submittals:

1. Submit manufacturer's environmental documentation and applicable sustainability program credits that are available to contribute towards a LEED rated project certification.

G. Warranty: Sample of special warranties.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, latest edition, "Industry Standard for Architectural Wood Flush Doors’.

C. Fire Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing at positive pressure according to NFPA 252 (neutral pressure at 40” above sill) or UL 10C (neutral pressure testing according to UL 10B where specified).

1. Oversize Fire Rated Door Assemblies: For units exceeding sizes of tested assemblies provide manufacturer’s construction label, indicating compliance to independent 3rd party certification agency’s procedure, except for size.

2. Temperature Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire test exposure.

3. Smoke Control Door Assemblies: Comply with NFPA 105.

    1) Smoke "S" Label: Doors to bear “S” label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

4. Blocking: When through-bolts are not to be used, indicate size and location of blocking in 45, 60 and 90 minute mineral core doors.

D. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for receiving, handling, and installing flush wood doors.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package pre-finished doors individually in plastic bags or cardboard cartons and wrap bundles of doors in plastic sheeting.

C. Mark each door on top rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
    b. Telegraphing of core construction in wood face veneers exceeding 0.01 inch in a 3-inch span.
    c. Telegraphing of core construction and delaminating of face in decorative laminate-faced doors.

2. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

3. Warranty Period for Solid Core Interior Doors: Life of installation according to manufacturer's written warranty.

PART 2 - PRODUCTS

2.1 DOOR CONSTRUCTION – GENERAL

A. WDMA I.S.1-A Performance Grade: Extra Heavy Duty; Aesthetic Grade: Premium.

B. Fire Rated Doors: Provide construction and core specified above as needed to provide fire ratings indicated.

1. Category A Edge Construction: Provide 45, 60 and 90 minute fire rated doors edge construction with intumescent seals concealed by outer stile (Category A). Comply with specified requirements for exposed edges.

2. Pairs: Provide fire retardant stiles that are listed and labeled for applications indicated without formed steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

a. Where required or specified, provide formed steel edges and astragals with intumescent seals. Finish steel edges and astragals with baked enamel.

2.2 CORE CONSTRUCTION

A. Particleboard Core Doors:

1. Particleboard: Wood fiber based materials complying with ANSI A208.1 Particleboard standard. Grade LD-2.
2. Adhesive: Fully bonded construction using Polyurethane (PUR) glue.
3. Blocking: When through-bolted hardware is not used, provide wood blocking in particleboard core doors as follows:

a. 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.
b. 5-inch (125-mm) mid-rail blocking, in doors indicated to have exit devices.

1) Optional Cores for Blocking: Provide doors with either glued-wood-stave or structural-composite-lumber core instead of particleboard core for doors indicated to receive closers and exit devices.

4. Basis of Design:

a. Graham: PC, PC5

2.3 VENEERED DOORS FOR TRANSPARENT FINISH

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Graham: GPD
2. Marshfield Signature
3. VT Artistry

B. Interior Solid Core Doors:

1. Grade: Premium

2. Faces: Veneer grades as noted below; veneer minimum 1/50-inch (0.5mm) thickness at moisture content of 12% or less.

   a. Plain Sliced Red Oak.

3. Match between Veneer Leaves: Book match.

4. Assembly of Veneer Leaves on Door Faces:

   a. Running Match.

5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
6. Room Match: Match door faces within each separate room or area of building. Corridor door faces do not need to match where they are separated by 10 feet or more.
7. Transom Match: Continuous match.
8. Vertical Edges: Matching same species as faces. Wood or composite material, one piece, laminated, or veneered. Minimum requirements per WDMA section P-1, Performance Standards for Architectural Wood Flush Doors.
9. Horizontal Edges: Solid wood or structural composite material meeting the minimum requirements per WDMA section P-1, Performance Standards for Architectural Wood Flush Doors
10. Construction: Five plies. Stiles and rails are bonded to core, then entire unit sanded before applying face veneers.
11. At doors over 40% of the face cut-out for lights and or louvers, furnish engineered composite lumber core.

2.4 LIGHT FRAMES AND GLAZING

A. Wood Beads for Light Openings in Wood Doors up to and including 20-minute rating:

1. Wood Species: Same species as door faces.
2. Profile: Manufacturer’s standard lipped profile. At wood core doors with 20-minute fire protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with the flush wood door manufacturer's written instructions.

2.5 FABRICATION

A. Factory fit doors to suit frame opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with requirements in NFPA 80 for fire rated doors.

B. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. Metal Astragals: Factory machine astragals and formed steel edges for hardware for pairs of fire rated doors.

C. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.

D. Openings: Cut and trim openings through doors in factory.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Comply with applicable requirements in Division 08 Section "Glazing."
3. Louvers: Factory install louvers in prepared openings.

E. Electrical Raceways: Provide flush wood doors receiving electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through wire transfer hardware or wiring harness specified in hardware sets in Division 08 "Door Hardware". Wire nut connections are not acceptable.

2.6 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Transparent Finish: Provide a clear protective coating over the wood veneer allowing the natural color and grain of the selected wood species to provide the appearance specified. Stain is applied to the wood surface underneath the transparent finish to add color and design flexibility.

1. Grade: Premium.
2. Finish: Meet or exceed WDMA I.S. 1A TR6 Catalyzed Polyurethane finish performance requirements.
3. Staining: As selected by Architect from manufacturer's full range.
4. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Division 8 Section "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.

1. Install fire rated doors in corresponding fire rated frames according to NFPA 80.

C. Factory Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Re-hang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Access doors and frames for walls and ceilings.

B. Related Requirements:

1. Division 23 Section "Air Duct Accessories" for heating and air-conditioning duct access doors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details materials, individual components and profiles, and finishes.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Detail fabrication and installation of access doors and frames for each type of substrate.

C. Samples: For each door face material, at least 3 by 5 inches (75 by 125 mm) in size, in specified finish.

D. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics according to the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Access Panel Solutions.
2. Acudor Products, Inc.
3. Alfab, Inc.
4. Babcock-Davis.
5. Cendrex Inc.
6. Elmdor/Stoneman Manufacturing Co.; Div. of Acorn Engineering Co.
7. Jensen Industries; Div. of Broan-Nutone, LLC.
8. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
9. Karp Associates, Inc.
10. Larsen's Manufacturing Company.
11. Maxam Metal Products Limited.
12. Metropolitan Door Industries Corp.
13. MIFAB, Inc.
14. Milcor Inc.
15. Nystrom, Inc.
16. Williams Bros. Corporation of America (The).

B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

C. Flush Access Doors with Exposed Flanges:

1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
2. Locations: Wall and ceiling.
3. Door Size: As required for access to device.
4. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage.

   a. Finish: Factory prime.

5. Frame Material: Same material, thickness, and finish as door>.
6. Hinges: Manufacturer's standard.
7. Hardware: Latch.

D. Hardware:

1. Latch: Cam latch.

2.3 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

C. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

E. Rolled-Stainless-Steel Floor Plate: ASTM A 793, manufacturer's standard finish.

F. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304. Remove tool and die marks and stretch lines or blend into finish.

G. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

H. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

I. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of Alloy 5005-H15; with minimum sheet thickness according to ANSI H35.2 (ANSI H35.2M).

J. Frame Anchors: Same type as door face.

K. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.4 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded metal lath and exposed casing bead welded to perimeter of frames.
3. Provide mounting holes in frames for attachment of units to metal or wood framing.
4. Provide mounting holes in frame for attachment of masonry anchors.

D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.

1. For recessed doors with plaster infill, provide self-furring expanded metal lath attached to door panel.

E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

1. For cylinder locks, furnish two keys per lock and key all locks alike.
2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

2.5 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Steel and Metallic-Coated-Steel Finishes:

1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior and interior storefront framing.
2. Storefront framing for punched openings.
3. Exterior and interior manual-swing entrance doors and door-frame units.

B. Related Sections:

1. Division 08 Section "Automatic Entrances" for automatic entrances.
2. Division 08 Section "Louvers And Vents" for units installed with aluminum-framed systems.

1.3 DEFINITIONS

A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities.", and the “Delaware Architectural Accessibility Standards”.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:

   a. Deflection exceeding specified limits.
   b. Thermal stresses transferring to building structure.

c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
d. Glazing-to-glazing contact.
e. Noise or vibration created by wind and by thermal and structural movements.
f. Loosening or weakening of fasteners, attachments, and other components.
g. Sealant failure.
h. Failure of operating units.

B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Structural Loads:

1. Wind Loads:

a. Basic Wind Speed: 90 mph (40 m/s).

D. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.

E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
2. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

F. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa).

G. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

H. Water Penetration under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

1. Maximum Water Leakage: No uncontrolled water penetrating aluminum-framed systems or water appearing on systems' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.

I. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).

3. Interior Ambient-Air Temperature: 75 deg F (24 deg C).

J. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.

K. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K) when tested according to AAMA 1503.

L. Sound Transmission: Provide aluminum-framed systems with fixed glazing and framing areas having the following sound-transmission characteristics:

1. Sound Transmission Class (STC): Minimum 30 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
2. Outdoor-Indoor Transmission Class (OITC): Minimum 30 OITC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and sealants used inside of the weatherproofing system, documentation including printed statement of VOC content.

C. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.

1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

F. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

G. Other Action Submittals:

1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

H. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of aluminum-framed systems.
2. Include design calculations.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and testing agency.

B. Seismic Qualification Certificates: For aluminum-framed systems**,** accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

C. Welding certificates.

D. Preconstruction Test Reports: For sealant.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.

F. Source quality-control reports.

G. Quality-Control Program for Structural-Sealant-Glazed System: Include reports.

H. Field quality-control reports.

I. Warranties: Sample of special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

D. Quality-Control Program for Structural-Sealant-Glazed System: Develop quality control program specifically for Project. Document quality-control procedures and verify results for aluminum-framed systems. Comply with ASTM C 1401 recommendations including, but not limited to, system material-qualification procedures, preconstruction sealant-testing program, procedures for system fabrication and installation, and intervals of reviews and checks.

E. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

F. Preconstruction Sealant Testing: For structural-sealant-glazed systems, perform sealant manufacturer's standard tests for compatibility with and adhesion of each material that will come in contact with sealants and each condition required by aluminum-framed systems.

1. Test a minimum five samples each of metal, glazing, and other material.
2. Prepare samples using techniques and primers required for installed systems.
3. For materials that fail tests, determine corrective measures necessary to prepare each material to ensure compatibility with and adhesion of sealants including, but not limited to, specially formulated primers. After performing these corrective measures on the minimum number of samples required for each material, retest materials.

G. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and [ICC/ANSI A117.1.

H. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.

I. Structural-Sealant Glazing: Comply with ASTM C 1401, "Guide for Structural Sealant Glazing" for design and installation of structural-sealant-glazed systems.

J. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.

K. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."

L. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of window SF-5, in Office 161, using typical exterior wall assembly as indicated on the drawings, or provide independent free standing section of exterior wall with window SF-5 and typical exterior wall assembly.
2. Field testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

M. Preinstallation Conference: Conduct conference at Project site.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration caused by thermal movements.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
d. Adhesive or cohesive sealant failures.
e. Water leakage through fixed glazing and framing areas.
f. Failure of operating components.

2. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 10 years from date of Substantial Completion.

1.11 MAINTENANCE SERVICE

A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Arcadia, Inc.
2. Arch Aluminum & Glass Co., Inc.
3. CMI Architectural
4. Commercial Architectural Products, Inc.
5. EFCO Corporation.
6. Kawneer North America; an Alcoa company.
7. Leed Himmel Industries, Inc.
8. Pittco Architectural Metals, Inc.
9. TRACO.
10. Tubelite.
11. United States Aluminum.
12. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
13. YKK AP America Inc.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Center.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.

E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

1. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Division 08 Section "Glazing."

B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

E. Glazing Sealants: For structural-sealant-glazed systems, as recommended by manufacturer for joint type, and as follows:

1. Structural Sealant: ASTM C 1184, single-component neutral-curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by a structural-sealant manufacturer for use in aluminum-framed systems indicated.

    a. Sealants used inside the weatherproofing system shall have a VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    b. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
    c. Color: Black.

2. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; single-component neutral-curing formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use.

    a. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    b. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
    c. Color: Matching structural sealant.

2.5 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.

1. Door Construction: 2-inch (50.8-mm) overall thickness, with minimum 0.188-inch- (4.8-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

2. Door Design: Wide style – 5” nominal width.

    a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches (255 mm) above floor or ground plane.

3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

    a. Provide nonremovable glazing stops on outside of door.

B. Entrance Door Hardware: As specified in Division 08 Section "Door Hardware."

2.6 ENTRANCE DOOR HARDWARE

A. General: See Section 078100 for door hardware.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Opening-Force Requirements:

a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.

B. Opening-Force Requirements:

1. Delayed-Egress Locks: Lock releases within 15 seconds after applying a force of not more than 15 lbf (67 N) for not more than 3 seconds.
2. Latches and Exit Devices: Not more than 15 lbf (67 N) required to release latch.

C. Butt Hinges: BHMA A156.1, Grade 1, radius corner.

1. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
2. Exterior Hinges: Stainless steel, with stainless-steel pin.
3. Quantities:

a. For doors up to 87 inches (2210 mm) high, provide 3 hinges per leaf.
b. For doors more than 87 and up to 120 inches (2210 and up to 3048 mm) high, provide 4 hinges per leaf.

D. Continuous-Gear Hinges: Manufacturer's standard with stainless-steel bearings between knuckles, fabricated to full height of door and frame.

E. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.

F. Manual Flush Bolts: BHMA A156.16, Grade 1.

G. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.

H. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

I. Cylinders: As specified in Division 08 Section "Door Hardware."

   1. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation.

J. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

K. Operating Trim: BHMA A156.6.

L. Removable Mullions: BHMA A156.3, extruded aluminum.

   1. When used with panic exit devices, provide removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.

M. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to meet field conditions and requirements for opening force.

N. Concealed Overhead Holders: BHMA A156.8, Grade 1.

O. Surface-Mounted Holders: BHMA A156.16, Grade 1.

P. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

Q. Weather Stripping: Manufacturer's standard replaceable components.

   1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
   2. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

R. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

S. Silencers: BHMA A156.16, Grade 1.

T. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (13 mm).

U. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

2.7 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."

1. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil (0.762-mm) thickness per coat.

2.8 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from exterior.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Storefront Framing: Fabricate components for assembly using head-and-sill-receptor system with shear blocks at intermediate horizontal members.

F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At exterior doors, provide compression weather stripping at fixed stops.

2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: Dark bronze.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to evaluate structural-sealant-glazed systems.

B. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.

2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing as specified in Division 08 Section "Glazing."

1. Structural-Sealant Glazing:

a. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
b. Install weatherseal sealant according to Division 07 Section "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

3.3 ERECTION TOLERANCES

A. Install aluminum-framed systems to comply with the following maximum erection tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
2. Alignment:

   a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).
   b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive phases as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.

1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches (75 mm) from the latch, measured to the leading door edge.

END OF SECTION 084113

SECTION 084126 - ALL-GLASS ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior manual-swinging all-glass entrance doors.
2. All-glass sidelights.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for overhead-steel support for all-glass systems.
2. Division 08 Section "Aluminum-Framed Entrances and Storefronts" for storefront systems that incorporate all-glass entrance doors.
3. Division 08 Section "Glazing" for general glass requirements.

1.3 DEFINITIONS

A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: All-glass systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Structural Performance: All-glass systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.

C. Delegated Design: Design all-glass systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

D. Thermal Movements: Allow for thermal movements resulting from the following ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C, material surfaces.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for all-glass system.

B. Shop Drawings: Show fabrication and installation details, including the following:

1. Plans, elevations, and sections.
2. Details of fittings and glazing, including isometric drawings of patch and rail fittings.
3. Door hardware locations, mounting heights, and installation requirements.

C. Samples for Initial Selection: For each type of exposed finish indicated.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Finishes: 6-inch- (150-mm-) long sections of patch and rail fittings, accessory fittings, and other items.
2. Glass: 6 inches (150 mm) square, showing exposed-edge finish.
3. Door Hardware: For exposed door hardware of each type, in specified finish, full size.

E. Fabrication Sample: Of patch fitting at sill on pivot side only of all-glass systems, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:

1. Joinery.
2. Anchorage.
3. Glazing.

F. Other Action Submittals:

1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, sidelights, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

G. Delegated-Design Submittal: For all-glass systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of all-glass systems.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and testing agency.

B. Seismic Qualification Certificates: For all-glass systems, accessories, and components, from manufacturer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for all-glass systems.

D. Field quality-control reports.

E. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For all-glass systems to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Engineering Responsibility: Prepare data for all-glass systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

D. Source Limitations: Obtain all-glass systems from single source from single manufacturer.

E. Accessible All-Glass Entrance Doors: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

F. Preinstallation Conference: Conduct conference at Project site.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with all-glass systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of all-glass systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
c. Failure of operating components.

2. Warranty Period: Two years from date of Substantial Completion, except as follows:

a. Concealed Floor Closers: Five years from date of Substantial Completion.

1.11 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of all-glass system Installer. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper all-glass system operation. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

B. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Oldcastle Glass, Inc., P Style all-glass entrance doors and sidelights or comparable product by one of the following:

1. ACI Distribution; a division of Vitro America, Inc.
2. Alpha Door & Rail, Inc.
3. Arch Aluminum & Glass Co., Inc.
4. Blumcraft of Pittsburgh.
5. Virginia Glass Products Corporation; a subsidiary of Virginia Mirror Company.
6. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.

2.2 MATERIALS

A. Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), tested for surface and edge compression per ASTM C 1048 and for impact strength per 16 CFR 1201 for Category II materials.

1. Class 1: Clear monolithic.

a. Thickness: 1/2 inch (13 mm).
b. Locations: As indicated.

2. Exposed Edges: Machine ground and flat polished.
3. Butt Edges: Flat ground.
4. Corner Edges: Lap-joint corners with exposed edges polished.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), with strength and durability characteristics of not less than Alloy 6063-T5.
1. Stainless-Steel Cladding: ASTM A 666, Type 304.

2.3 METAL COMPONENTS

A. Fitting Configuration:

1. Manual-Swinging, All-Glass Entrance Doors and Sidelights: Patch fittings at head and sill on pivot side only.

B. Patch Fittings: Stainless-steel-clad aluminum.

C. Rail Fittings:

1. Material: Stainless-steel-clad aluminum.
2. Height:

a. Top Rail: 3-1/2 inches (89 mm).
b. Bottom Rail: 10 inches (255 mm).

3. Profile: Square.
4. End Caps: Manufacturer's standard precision-fit end caps for rail fittings.

D. Accessory Fittings: Match patch- and rail-fitting metal and finish for the following:

1. Overhead doorstop.
2. Center-housing lock.
3. Glass-support-fin brackets.

E. Anchors and Fastenings: Concealed.

2.4 ENTRANCE DOOR HARDWARE

A. General: Heavy-duty entrance door hardware units in sizes, quantities, and types recommended by manufacturer for all-glass entrance systems indicated. For exposed parts, match metal and finish of patch and rail fittings.

B. Concealed Floor Closers and Top Pivots: Center hung; BHMA A156.4, Grade 1; including cases, bottom arms, top walking beam pivots, plates, and accessories required for complete installation.

1. Swing: Single acting.

a. Positive Dead Stop: Coordinated with hold-open angle if any, or at angle selected.

2. Hold Open: Automatic, at angle selected.
3. Opening-Force Requirements:

a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
b. Accessible Interior Swinging Doors: Not more than 5 lbf (22.2 N) to fully open door.

C. Concealed Overhead Holder: BHMA A156.8, Grade 1, with dead-stop setting coordinated with concealed floor closer.

D. Push-Pull Set: As specified in Division 08 Section "Door Hardware.

E. Single-Door and Active-Leaf Locksets: As specified in Division 08 Section "Door Hardware.

F. Inactive-Leaf Locksets: As specified in Division 08 Section "Door Hardware.

G. Cylinders: As specified in Division 08 Section "Door Hardware.

2.5 FABRICATION

A. Provide holes and cutouts in glass to receive hardware, fittings, and accessory fittings before tempering glass. Do not cut, drill, or make other alterations to glass after tempering.

1. Fully temper glass using horizontal (roller-hearth) process, and fabricate so that when glass is installed, roll-wave distortion is parallel with bottom edge of door or lite.

B. Factory assemble components and factory install hardware and fittings to greatest extent possible.

2.6 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install all-glass systems and associated components according to manufacturer's written instructions.

B. Set units level, plumb, and true to line, with uniform joints.

C. Maintain uniform clearances between adjacent components.

D. Lubricate hardware and other moving parts according to manufacturer's written instructions.

E. Set, seal, and grout floor closer cases as required to suit hardware and substrate indicated.

F. Install joint sealants as specified in Division 07 Section "Joint Sealants".

3.3 ADJUSTING AND CLEANING

A. Adjust all-glass entrance doors and hardware to produce smooth operation and tight fit at contact points and weather stripping.

1. For all-glass entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches (75 mm) from the latch measured to the leading door edge.

B. Remove excess sealant and glazing compounds and dirt from surfaces.

END OF SECTION 084126

SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes aluminum windows for exterior locations.

B. Related Requirements:

1. Division 08 Section "Aluminum-Framed Entrances and Storefronts" for coordinating finish among aluminum fenestration units.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchorage, flashing, sealing perimeters, and protecting finishes.
4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.

B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples: For each exposed product and for each color specified, 2 by 4 inches (50 by 100 mm) in size.

D. Samples for Initial Selection: For units with factory-applied color finishes.

1. Include similar Samples of hardware and accessories involving color selection.

E. Samples for Verification: For aluminum windows and components required, showing full range of color variations for finishes, and prepared on Samples of size indicated below:

1. Exposed Finishes: 2 by 4 inches (50 by 100 mm).
2. Exposed Hardware: Full-size units.

F. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For manufacturer's warranties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports, and calculations.

B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet performance requirements.
b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
c. Faulty operation of movable sash and hardware.
d. Deterioration of materials and finishes beyond normal weathering.
e. Failure of insulating glass.

2. Warranty Period:

a. Window: 10 years from date of Substantial Completion.
b. Glazing Units: Five years from date of Substantial Completion.
c. Aluminum Finish: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. All Seasons Window & Door Mfg., Inc.; All Seasons Commercial Division, Inc.
2. Boyd Aluminum Manufacturing.
3. Custom Window Company.
4. DeSCo Architectural Inc.
5. EFCO Corporation; a Pella company.
6. EXTECH Exterior Technologies, Inc.
7. Fleetwood Windows & Doors.
8. Gerkin Windows and Doors.
9. Graham Architectural Products Corp.
10. Kawneer North America; an Alcoa company.
11. Mannix Exterior Wall Systems, Inc.
12. Peerless Products Inc.
13. Quaker Windows Products Co.
14. Thermal Windows, Inc.
15. TRACO.
16. Wausau Window and Wall Systems.
17. Winco.
18. YKK AP America Inc.

B. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: AMMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: AW.
2. Minimum Performance Grade: 50.

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.30 Btu/sq. ft. x h x deg F (1.71 W/sq. m x K.

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.30.

E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.

F. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C) material surfaces

G. Sound Transmission Class (STC): Rated for not less than 26 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.

H. Outside-Inside Transmission Class (OITC): Rated for not less than 26 OITC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.

2.3 ALUMINUM WINDOWS

A. Operating Types: Provide the following operating types in locations indicated on Drawings:

1. Awning: Project out, to match existing.

B. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.

1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.
   a. Frame and sash style to match existing

C. Insulating-Glass Units: ASTM E 2190, certified through IGCC as complying with requirements of IGCC.

1. Glass: ASTM C 1036, Type 1, Class 1, q3.

   a. Tint: Match existing.
   b. Kind: Fully tempered where indicated on Drawings.

2. Lites: Two.
3. Filling: Fill space between glass lites with argon.
4. Low-E Coating: Sputtered on second surface.

D. Glazing System: As specified in Section 8 - Glazing.

E. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.

1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.

F. Projected Window Hardware:

1. Operator: Manufacturer’s standard project-out cams handle with strike.

   a. Type and Style: Match existing.

2. Hinges: Non-friction type, not less than two per sash.
3. Lock: Lever handle and cam-action lock with keeper.

G. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

H. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 INSECT SCREENS

A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Provide hinged wickets to match existing..

1. Type and Location: Full, inside for project-out sashes.

B. Aluminum Frames: Manufacturer's standard aluminum alloy complying with SMA 1004 or SMA 1201. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.

1. Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet.

2.5 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Glaze aluminum windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.

F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design wind loads of window units.

G. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

1. Color: Match Existing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:

1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
2. Air-Infiltration Testing:

   a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
   b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.

3. Water-Resistance Testing:

   a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
   b. Allowable Water Infiltration: No water penetration.

4. Testing Extent: Three windows of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
5. Test Reports: Prepared according to AAMA 502.

C. Remove and replace noncomplying windows and retest as specified above.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Prepare test and inspection reports.

3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

1. Keep protective films and coverings in place until final cleaning.

C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 085113

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware, power supplies, back-ups and surge protection.
3. Automatic operators.
4. Cylinders specified for doors in other sections.

C. Related Sections:

1. Section 06 10 00 – Rough Carpentry.
2. Section 06 20 00 – Finish Carpentry.
3. Section 08 11 13 – Hollow Metal Doors and Frames.
4. Section 08 14 16 – Flush Wood Doors.
5. Section 08 41 13 – Aluminum-Framed Entrances and Storefronts.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 80 - Fire Doors and Windows.
4. NFPA 101 - Life Safety Code.
5. NFPA 105 - Installation of Smoke Door Assemblies.
6. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards - A156 Series
2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware.
g. Door and frame sizes and materials.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.

2. Electrical Coordination: Coordinate with related Division 26 Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

F. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum 3 years documented experience installing both standard and electrified builders hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor in good standing by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

1. Scheduling Responsibility: Preparation of door hardware and keying schedules.

D. Automatic Operator Supplier Qualifications: Power operator products and accessories are required to be supplied and installed through current members of the manufacturer's "Power Operator Preferred Installer" program. Suppliers are to be factory trained, certified, and a direct purchaser of the specified power operators and be responsible for the installation and maintenance of the units and accessories indicated for the Project.

E. Source Limitations: Obtain each type and variety of Door Hardware specified in this Section from a single source, qualified supplier unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:

1. NFPA 70 "National Electrical Code", including electrical components, devices, and accessories listed and labeled as defined in Article 100 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

2. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:

a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
b. Door Closers: Comply with the following maximum opening-force requirements indicated:

1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.

3. NFPA 101: Comply with the following for means of egress doors:

a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.

b. Thresholds: Not more than 1/2 inch high.

4. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40" above sill) or UL-10C.

    a. Test Pressure: Positive pressure labeling.

G. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

H. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

I. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, arrange for manufacturers' representatives to hold a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

J. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Related Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Ten years for mortise locks and latches.
2. Ten years for extra heavy duty cylindrical (bored) locks and latches.
3. Seven years for heavy duty cylindrical (bored) locks and latches.
4. Five years for standard duty cylindrical (bored) locks and latches.
5. Five years for exit hardware.
6. Twenty five years for manual door closers.
7. Two years for electromechanical door hardware.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Continuing Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

1. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

a. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

B. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity, unless otherwise indicated:

a. Two Hinges: For doors with heights up to 60 inches.
b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.
d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:

a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the following applications:

1) Out-swinging exterior doors.
2) Out-swinging access controlled doors.
3) Out-swinging lockable doors.

5. Acceptable Manufacturers:

a. Bommer Industries (BO).
b. Hager Companies (HA).
c. McKinney Products (MK).

B. Continuous Geared Hinges: ANSI/BHMA A156.26 certified continuous geared hinge with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Provide concealed flush mount (with or without inset), full surface, or half surface, in standard and heavy duty models, as specified in the Hardware Sets. Concealed continuous

hinges to be U.L. listed for use on up to and including 90 minute rated door installations and U.L. listed for windstorm components where applicable. Factory cut hinges for door size and provide with removable service power transfer panel where indicated at electrified openings.

1. Acceptable Manufacturers:

    a. Bommer Industries (BO).
    b. McKinney Products (MK).
    c. Pemko Manufacturing (PE).

2.3 POWER TRANSFER DEVICES

A. Electrified Quick Connect Continuous Geared Transfer Hinges: Provide electrified transfer continuous geared hinges with a 12" removable service panel cutout accessible without de-mounting door from the frame. Furnish with Molex™ standardized plug connectors with sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Acceptable Manufacturers:

    a. Bommer Industries (BO) - SER-QC (# of wires) Option.
    b. McKinney Products (MK) - SER-QC (# wires) Option.
    c. Pemko Manufacturing (PE) - SER-QC (# wires) Option.

B. Electrified Quick Connect Intermediate Transfer Pivots: Provide electrified offset intermediate transfer pivot hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Acceptable Manufacturers:

    a. Rixson Door Controls (RF) - E-M19-QC (# wires).

C. Electric Door Hardware Cords: Provide electric transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Acceptable Manufacturers:

a. McKinney Products (MK) – QC-C Series.

Provide one each of the following tools as part of the base bid contract:

a. McKinney Products (MK) - Electrical Connecting Kit: QC-R001.
b. McKinney Products (MK) - Connector Hand Tool: QC-R003.

2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified automatic, self-latching, and manual flush bolts and surface bolts. Manual flush bolts to be furnished with top rod of sufficient length to allow bolt location approximately six feet from the floor. Furnish dust proof strikes for bottom bolts. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

1. Acceptable Manufacturers:

a. Door Controls International (DC).
b. Rockwood Manufacturing (RO).
c. Trimco (TC).

B. Door Push Plates and Pulls: ANS/BHMA A156.6 certified door pushes and pulls of type and design specified below or in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, 4-inches wide by 16-inches high, with square corners and beveled edges, secured with exposed screws unless otherwise indicated.
2. Straight Pull Design: Minimum 1-inch round diameter stainless steel bar or tube stock pulls with 2 1/2-inch projection from face of door unless otherwise indicated.
3. Offset Pull Design: Minimum 1-inch round diameter stainless steel bar or tube stock pulls with 2 1/2-inch projection and offset of 90 degrees unless otherwise indicated.
4. Push Bars: Minimum 1-inch round diameter horizontal push bars with minimum clearance of 2 1/2-inch projection from face of door unless otherwise indicated.
5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

a. Acceptable Manufacturers:

1) Hiawatha, Inc. (HI).
2) Rockwood Manufacturing (RO).
3) Trimco (TC).

2.5 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

1. Acceptable Manufacturers:

a. Stanley Best (BE).

C. Cylinders: Original manufacturer cylinders complying with the following:

1. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.

D. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:

1. Interchangeable Cores: Core insert, removable by use of a special key; usable with other manufacturers' cylinders.

E. Keying System: Each type of lock and cylinders to be factory keyed. Conduct specified "Keying Conference" to define and document keying system instructions and requirements. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner. Incorporate decisions made in keying conference, and as follows:

1. Master Key System: Cylinders are operated by a change key and a master key.
2. Grand Master Key System: Cylinders are operated by a change key, a master key, and a grand master key.
3. Great-Grand Master Key System: Cylinders are operated by a change key, a master key, a grand master key, and a great-grand master key.
4. Existing System: Master key or grand master key locks to Owner's existing system.
5. Keyed Alike: Key all cylinders to same change key.

F. Key Quantity: Provide the following minimum number of keys:

1. Top Master Key: One (1)
2. Change Keys per Cylinder: Two (2)
3. Master Keys (per Master Key Group): Two (2)
4. Grand Master Keys (per Grand Master Key Group): Two (2)
5. Construction Control Keys (where required): Two (2)
6. Permanent Control Keys (where required): Two (2)

G. Construction Keying: Provide construction master keyed cylinders or temporary keyed construction cores where specified. Provide construction master keys in quantity as required by project Contractor. Replace construction cores with permanent cores. Furnish permanent cores for installation as directed under specified "Keying Conference".

H. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall expansion capacity of 150% of the number of locks required for the project.

1. Acceptable Manufacturers:

a. Lund Equipment (LU).
b. Telkee (TK).

2.6 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified mortise locksets furnished in the functions as specified in the Hardware Sets. Locksets to be manufactured with a corrosion resistant, stamped 12 gauge minimum formed steel case and be field-reversible for handing without disassembly of the lock body. Lockset trim (including knobs, levers, escutcheons, roses) to be the product of a single manufacturer. Furnish with standard 2 3/4" backset, 3/4" throw anti-friction stainless steel latchbolt, and a full 1" throw stainless steel bolt for deadbolt functions.

1. Acceptable Manufacturers:

a. Stanley Best (BE) – 47H Series.

B. Lock Trim Design: As specified in Hardware Sets.

2.7 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.

2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.5.
4. Dustproof Strikes: BHMA A156.16.

2.8 ELECTRIC STRIKES

A. Standard Electric Strikes: Heavy duty, cylindrical and mortise lock electric strikes conforming to ANSI/BHMA A156.31, Grade 1, UL listed for both Burglary Resistance and for use on fire rated door assemblies. Stainless steel construction with dual interlocking plunger design tested to exceed 3000 lbs. of static strength and 350 ft-lbs. of dynamic strength. Strikes tested for a minimum 1 million operating cycles. Provide strikes with 12 or 24 VDC capability and supplied standard as fail-secure unless otherwise specified. Option available for latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike.

1. Acceptable Manufacturers:

a. Folger Adam EDC (FO).
b. HES (HS).

B. Surface Mounted Rim Electric Strikes: Surface mounted rim exit device electric strikes conforming to ANSI/BHMA A156.31, Grade 1, and UL Listed for both Burglary Resistance and for use on fire rated door assemblies. Construction includes internally mounted solenoid with two heavy-duty, stainless steel locking mechanisms operating independently to provide tamper resistance. Strikes tested for a minimum of 500,000 operating cycles. Provide strikes with 12 or 24 VDC capability supplied standard as fail-secure unless otherwise specified. Option available for latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike. Strike requires no cutting to the jamb prior to installation.

1. Acceptable Manufacturers:

a. HES (HS) - 9500/9600 Series.

C. Provide electric strikes with in-line power controller and surge suppressor by the same manufacturer as the strike with combined products having unlimited lifetime warranty.

2.9 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.

    a. Fire Exit Removable Mullions: Provide keyed removable mullions for use with fire exit devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252. Mullions to be used only with exit devices for which they have been tested.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Flush End Caps: Provide heavy weight impact resistant flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.

5. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty trim with cold forged escutcheons, beveled edges, and four threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets. Provided free-wheeling type trim where indicated.
    b. Where function of exit device requires a cylinder, provide an interchangeable core type keyed cylinder (Rim or Mortise) as specified in Hardware Sets.

6. Vertical Rod Exit Devices: Provide and install interior surface and concealed vertical rod exit devices as Less Bottom Rod (LBR) unless otherwise indicated.

7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.

8. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

9. Rail Sizing: Provide exit device rails factory sized for proper door width application.

10. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Mounting rails to be formed from smooth stainless steel, brass or bronze architectural materials no less than 0.072" thick, with push rails a minimum of 0.062" thickness. Painted or aluminum metal rails are not acceptable. Exit device latch to be investment cast stainless steel, pullman type, with deadlock feature.

1. Acceptable Manufacturers:

    a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
    b. Sargent Manufacturing (SA) - 80 Series.
    c. Von Duprin (VD) - 35A/98/99 XP Series.

2.10 ELECTROMECHANICAL CONVENTIONAL EXIT DEVICES

A. Electrified Conventional Push Rail Devices (Heavy Duty): Subject to same compliance standards and requirements as mechanical exit devices, electrified devices to be of type and design as specified below.

1. Acceptable Manufacturers:

    a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
    b. Sargent Manufacturing (SA) - 80 Series.
    c. Von Duprin (VD) - 35A/98/99 Series.

B. Electrified Options: As indicated in hardware sets, provide electrified exit device options including: electric latch retraction, electric dogging, outside door trim control, exit alarm, delayed egress, latchbolt monitoring, lock/unlock status monitoring, touchbar monitoring and request-to-exit signaling. Unless otherwise indicated, provide electrified exit devices standard as fail secure.

2.11 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.

2. Standards: Closers to comply with UL-10C and UBC 7-2 for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.

4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

    a. Where closers are indicated to have mechanical dead-stop, provide heavy duty arms and brackets with an integral positive stop.

b. Where closers are indicated to have mechanical hold open, provide heavy duty units with an additional built-in mechanical holder assembly designed to hold open against normal wind and traffic conditions. Holder to be manually selectable to on-off position.
c. Where closers are indicated to have a cushion-type stop, provide heavy duty arms and brackets with spring stop mechanism to cushion door when opened to maximum degree.
d. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics. Provide drop plates or other accessories as required for proper mounting.

5. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt or security type fasteners as specified in the door Hardware Sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Acceptable Manufacturers:

a. Corbin Russwin Hardware (RU) - DC8000 Series.
b. LCN Closers (LC) - 4040XP Series.
c. Sargent Manufacturing (SA) - 351 Series.
d. Norton Door Controls (NO) - 7500 Series.

2.12 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Metal Protection Plates: ANSI/BHMA A156.6 certified metal protection plates (kick, armor, or mop), beveled on four edges (B4E), fabricated from the following.

a. Stainless Steel: 050-inch thick, with countersunk screw holes (CSK).
b. Brass or Bronze: 050-inch thick, with countersunk screw holes (CSK).

c. Laminate Plastic or Acrylic: 1/8-inch thick, with countersunk screw holes (CSK).

4. Fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets.

5. Metal Door Edging: Door protection edging fabricated from a minimum .050-inch thick metal sheet, formed into an angle or "U" cap shapes, surface or mortised mounted onto edge of door. Provide appropriate leg overlap to account for protection plates as required. Height to be as specified in the Hardware Sets.

6. Acceptable Manufacturers:

a. Hiawatha, Inc. (HI).
b. Rockwood Manufacturing (RO).
c. Trimco (TC).

2.13 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Acceptable Manufacturers:

a. Hiawatha, Inc. (HI).
b. Rockwood Manufacturing (RO).
c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Acceptable Manufacturers:

a. Rixson Door Controls (RF).
b. Rockwood Manufacturing (RO).
c. Sargent Manufacturing (SA).

2.14 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

   1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: :Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

   1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Acceptable Manufacturers:

   1. Pemko Manufacturing (PE).
   2. Reese Enterprises, Inc. (RS).
   3. Zero International (ZE).

2.15 ELECTRONIC ACCESSORIES

A. Power Supplies: Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Include battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

   1. Acceptable Manufacturers:

      a. Corbin Russwin Hardware (RU) – 781N.
      b. Sargent Manufacturing (SA) – 3500 Series.
      c. Securitron Door Controls (SU) - BPS 12/24 Series.
      d. Von Duprin (VO) - PS.

2.16 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. and provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SCHEDULE

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. Manufacturer's Abbreviations:

1. MK - McKinney
2. RF - Rixson
3. RO - Rockwood
4. BE - Stanley Security Solutions Inc (BE)
5. AD - Adams Rite
6. RU - Corbin Russwin
7. HS - HES
8. NO - Norton
9. PE - Pemko
10. 00 - Other
11. SU - Securitron
12. LU - Lund Equipment Co., Inc.

Hardware Schedule

Set: 1.0
Doors: 110/1

2	Continuous Hinge	MCK-14HD SER-12 x LAR	CL	MK
1	Exit Device (concealed vertical rod, storeroom)	ED4800M O859 M94 M92	630	RU
1	Exit Device (concealed vertical rod, exit only)	ED4800 M92 M94	630	RU
1	Cylinder	1E-72/ 74	626	BE
2	Pull	RM3050-12	US32-316	RO
2	Concealed Overhead Holder/Stop	6-336	630	RF
1	Door Closer	PR7500H 7788 2018D	689	NO
2	Door Switch	692		NO
1	Automatic Operator	5930-RF1	689	NO
1	Threshold	171A MS10SS		PE
1	Weatherstrip	By door Manufacturer		00

2	ElectroLynx Harness	QC-C*** (Length as Required)	MK
1	Controller	781N-120	RU

Notes: CARD READER BY OTHERS.
BUSINESS HOURS OPERATIONS:
OUTSIDE OPERATION: DOORS UNLOCKED, PUSHING OUTSIDE PUSH BUTTON ACTIVATES OPERATOR ON ACTIVE DOOR.
INSIDE OPERATION: DOORS UNLOCKED, EGRESS IS BY EXIT DEVICE OR PUSHING BUTTON WHICH ACTIVATES OPERATOR.
AFTER HOURS OPERATION:
OUTSIDE OPERATION: DOORS LOCKED, OUTSIDE PUSH BUTTON IS NOT ACTIVE, PRESENTING AUTHORIZED CREDENTIAL TO CARD READER WILL UNLOCK EXIT DEVICE AND ACTIVATE OPERATOR PUSH BUTTON. EMERGENCY ACCESS IS BY KEY.
INSIDE OPERATION: DOORS LOCKED, EGRESS IS BY EXIT DEVICE, PUSHING PUSH BUTTON WILL UNLOCK EXIT AND ACTIVATE OPERATOR.

Set: 2.0
Doors: 110/2

2	Continuous Hinge	MCK-14HD SER-12 x LAR	CL	MK
1	Exit Device (concealed vertical rod, storeroom)	ED4800M O859 M94 M92	630	RU
1	Exit Device (concealed vertical rod, exit only)	ED4800 M92 M94	630	RU
1	Cylinder	1E-72/ 74	626	BE
2	Pull	RM3050-12	US32-316	RO
2	Concealed Overhead Holder/Stop	6-336	630	RF
1	Door Closer	PR7500H 7788 2018D	689	NO
2	Door Switch	692		NO
1	Automatic Operator	5930-RF1	689	NO
1	Weatherstrip	By door Manufacturer		00
2	Sweep	307APK		PE
2	ElectroLynx Harness	QC-C*** (Length as Required)		MK
1	Controller	781N-120		RU

Notes: CARD READER AND REMOTE RELEASE BUTTON BY OTHERS.
BUSINESS AND AFTER HOURS OPERATION:
OUTSIDE OPERATION: DOORS LOCKED, OUTSIDE PUSH BUTTON IS NOT ACTIVE UNTIL REMOTE RELEASE BUTTON IS PUSHED, PUSHING OUTSIDE OPERATOR PUSH BUTTON ACTIVATES OPERATOR, PRESENTING AUTHORIZED CREDENTIAL TO CARD READER WILL UNLOCK EXIT DEVICE AND ACTIVATE OPERATOR PUSH BUTTON. EMERGENCY ACCESS IS BY KEY.

INSIDE OPERATION: DOORS LOCKED, EGRESS IS BY EXIT DEVICE, PUSHING INTERIOR DOOR SWITCH WILL UNLOCK EXIT DEVICE AND ACTIVATE OPERATOR.

Set: 3.0
Doors: 149/1

1	Continuous Hinge	MCK-14HD x LAR	CL	MK
1	Exit Device (rim)	ED5200 M52	630	RU
2	Cylinder	1E-72/ 74	626	BE
1	Electric Strike	9600-12/24D-LBM 2004M 2005M	630	HS
1	Pull	RM3050-12	US32-316	RO
1	Concealed Overhead Holder/Stop	1-336	630	RF
1	Door Closer	PR7500H 7788 2018D	689	NO
1	Kickplate	K1050 10" x 2 " LDW 4BE	US32D	RO
1	Threshold	2005AT x LAR MSES25SS		PE
1	Gasketing	S88D (Head & Jambs)		PE
1	ElectroLynx Harness	QC-C1500P		MK
1	Power Supply	BPS-24 (Size as Required)		SU

Notes: CARD READER BY OTHERS. PRESENTING AUTHORIZED CREDENTIAL TO CARD READER WILL UNLOCK ELECTRIC STRIKE ALLOWING ACCESS. FREE EGRESS BY EXIT DEVICE.

Set: 4.0
Doors: 108/1, 126/2, 140/2, 144/1

1	Continuous Hinge	MCK-14HD x LAR	CL	MK
1	Exit Device (rim)	ED5200 M52	630	RU
1	Cylinder	1E-72/ 74	626	BE
1	Electric Strike	9600-12/24D-LBM 2004M 2005M	630	HS
1	Concealed Overhead Holder/Stop	1-336	630	RF
1	Door Closer	PR7500H 7788 2018D	689	NO
1	Kickplate	K1050 10" x 2 " LDW 4BE	US32D	RO
1	Threshold	2005AT x LAR MSES25SS		PE
1	Gasketing	S88D (Head & Jambs)		PE
1	ElectroLynx Harness	QC-C1500P		MK
1	Power Supply	BPS-24 (Size as Required)		SU

Notes: CARD READER BY OTHERS. PRESENTING AUTHORIZED CREDENTIAL TO CARD READER WILL UNLOCK ELECTRIC STRIKE ALLOWING ACCESS. FREE EGRESS BY EXIT DEVICE.
NEW HARDWARE ON EXISTING HM DOOR AND FRAME. VERIFY LOCKSET/ EXIT TYPE.

Set: 5.0
Doors: 102/1

2	Magnetic Lock	SAMBD	SU

2 Cylinder	1E-72/ 74	626	BE
2 Locking Pull	LP3401DBD LC	US32	RO
2 Floor Closer	28S 90	626	RF
1 Motion Sensor	XMS		SU
1 Push Button	EEB2		SU
1 Power Supply	BPS-24 (Size as Required)		SU

Notes: DURING BUSINESS HOURS BOTH LOCKING PULLS ARE UNLOCKED. EXTERIOR KEY OR INTERIOR THUMBURN THROWS DEADBOLT.
LOCK DOWN PROCEEDURE WILL LOCK MAGNETIC SHEAR LOCKS. ACTIVATION OF MOTION DETECTOR OR PUSHING EMERGENCY PUSH BUTTON WILL RELEASE MAGNETIC SHEAR LOCKS.

Set: 6.0
Doors: 124/1

8 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
2 Flush Bolt	555/557	US26D	RO
1 Dust Proof Strike	570	US26D	RO
1 Mortise Lock	ML2017 LC	626	RU
1 Cylinder	1E-72/ 74	626	BE
2 Push Plate	70C	US32D-MS	RO
2 Pull Plate	110x70C	US32D-MS	RO
2 Door Closer	CLP7500	689	NO
2 Kickplate	K1050 10" x 1" LDW 4BE	US32D	RO
2 Silencer	608		RO

1 Power supply, by Security Contractor
1 Mag lock, by Security Contractor
1 Push to Exit button, by Security Contractor
1 Motion sensor, by Security Contractor
1 Panic button, by Security Contractor

Notes: NEW WOOD DOOR AND HARDWARE IN EXISTING WOOD FRAME. VERIFY LOCKSET/EXIT TYPE.

Set: 7.0
Doors: 147/1

6 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
2 Flush Bolt	555/557	US26D	RO
1 Dust Proof Strike	570	US26D	RO
1 Storeroom Lock	45H7D 15H	626	BE
1 Dummy Trim	40HTK IS1 OS1 15H	626	BE
1 Cylinder	1E-72/ 74	626	BE
2 Silencer	608		RO

Set: 8.0
Doors: 1119/1, 139/1, 158/1

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Storeroom Lock	45H7D 15H	626	BE
1	Door Stop	409	US32D	RO
3	Silencer	608		RO

Set: 9.0
Doors: 109/1

3	Hinge	TA2714 x NRP 4-1/2" x 4-1/2"	US26D	MK
1	Storeroom Lock	45H7D 15H	626	BE
1	Door Stop	409	US32D	RO
3	Silencer	608		RO

Set: 10.0
Doors: 109/2, 140/1

4	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Storeroom Lock	45H7D 15H	626	BE
1	Door Closer	CLP7500	689	NO
1	Kickplate	K1050 10" x 2 " LDW 4BE	US32D	RO
3	Silencer	608		RO

Set: 11.0
Doors: 132/1

4	Hinge	TA2714 x NRP 4-1/2" x 4-1/2"	US26D	MK
1	Storeroom Lock	45H7D 15H	626	BE
1	Door Closer	CLP7500	689	NO
1	Kickplate	K1050 10" x 2 " LDW 4BE	US32D	RO
3	Silencer	608		RO

Set: 12.0
Doors: 113/1, 114/1, 115/1, 116/1, 117/1, 118/1, 120/1, 121/1, 122/1, 123/1, 126/1, 127/1, 130/1, 133/1, 134/1, 135/1, 136/1, 137/1, 138/1, 141/1, 148/1, 152/1, 153/1, 154/1, 155/1, 156/1, 159/1, 160/1, 161/1, 162/1, 163/1

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Office Lock	45H7AB 15H	626	BE
1	Door Stop	409	US32D	RO
3	Silencer	608		RO

Set: 13.0
Doors: 145/1, 150/1

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK

1	Classroom Lock	45H7R 15H	626	BE
1	Door Stop	409	US32D	RO
3	Silencer	608		RO

Set: 14.0
Doors: 124/3

Notes: EXISTING WOOD DOOR, FRAME AND HARDWARE TO REMAIN.

Set: 15.0
Doors: 112/1, 131/1, 144/2, 151/1, 157/2

4	Hinge	TA2714 x NRP 4-1/2" x 4-1/2"	US26D	MK
1	Storeroom Lock	45H7D 15H	626	BE
1	Electric Strike	1006-12/24-LBM 2004M 2005M	630	HS
1	Door Closer	CLP7500	689	NO
1	Kickplate	K1050 10" x 2 " LDW 4BE	US32D	RO
3	Silencer	608		RO
1	ElectroLynx Harness	QC-C1500P		MK
1	Power Supply	BPS-24 (Size as Required)		SU

Notes: CARD READER BY OTHERS.
BUSINESS HOUR OPERATION:
ELECTRIC STRIKE IS UNLOCKED ALLOWING FREE ACESS/EGRESS. LOCK DOWN SIGNAL LOCKS ELECTRIC STRIKE AND RESTICTS CREDENTIAL ACCESS BASED ON SECURITY PROTOCOLS.
AFTER HOURS:
PRESENTING AUTHORIZED CREDENTIAL TO CARD READER WILL UNLOCK ELECTRIC STRIKE ALLOWING ACCESS. FREE EGRESS BY LEVER.

Set: 16.0
Doors: 107/1

4	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Privacy Set	45H0LT 15H	626	BE
1	Kickplate	K1050 10" x 2 " LDW 4BE	US32D	RO
1	Door Stop	409	US32D	RO
3	Silencer	608		RO

Notes: EXISTING DOOR AND FRAME, NEW HARDWARE.

Set: 17.0
Doors: 128/1, 129/1

4	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK

1	Push Plate	70C	US32D-MS	RO
1	Pull Plate	110x70C	US32D-MS	RO
1	Door Closer	7500	689	NO
1	Kickplate	K1050 10" x 2 " LDW 4BE	US32D	RO
1	Door Stop	409	US32D	RO
3	Silencer	608		RO

Set: 18.0
Doors: 157/1

1	Continuous Hinge	MCK-14HD x LAR	CL	MK
1	Exit Device (rim)	ED4200 M52	630	RU
1	Cylinder	1E-72/ 74	626	BE
1	Electric Strike	9600-12/24D-LBM 2004M 2005M	630	HS
1	Pull	RM3050-12	US32-316	RO
1	Concealed Overhead Holder/Stop	1-336	630	RF
1	Door Closer	PR7500H 7788 2018D	689	NO
1	Kickplate	K1050 10" x 2 " LDW 4BE	US32D	RO
1	Threshold	2005AT x LAR MSES25SS		PE
1	Gasketing	S88D (Head & Jambs)		PE
1	ElectroLynx Harness	QC-C1500P		MK
1	Power Supply	BPS-24 (Size as Required)		SU

Notes: CARD READER BY OTHERS. PRESENTING AUTHORIZED CREDENTIAL TO CARD READER WILL UNLOCK ELECTRIC STRIKE ALLOWING ACCESS. FREE EGRESS BY EXIT DEVICE.

Set: 19.0
Doors: 101/2

3	Hinge	TA2714 x NRP 4-1/2" x 4-1/2"	US26D	MK
1	Storeroom Lock	45H7D 15H	626	BE
1	Door Stop	409	US32D	RO
3	Silencer	608		RO

Notes: EXISTING DOOR AND FRAME, NEW HARDWARE.

Set: 20.0
Doors: 125/1, 146/1

6	Hinge	TA2714 x NRP 4-1/2" x 4-1/2"	US26D	MK
2	Flush Bolt	555/557	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Storeroom Lock	45H7D 15H	626	BE
1	Dummy Trim	40HTK IS1 OS1 15H	626	BE
2	Kickplate	K1050 10" x 2 " LDW 4BE	US32D	RO
2	Door Stop	409	US32D	RO
2	Silencer	608		RO

Set: 21.0
Doors: 101/1, 103/1, 104/1, 105/1

4	Hinge	TA2714 x NRP 4-1/2" x 4-1/2"	US26D	MK
1	Office Lock	45H7AB 15H	626	BE
1	Door Stop	409	US32D	RO
3	Silencer	608		RO

Notes: EXISTING DOOR AND FRAME, NEW HARDWARE.

Set: 22.0
Doors: 101/3, 124/2

4	Hinge	TA2714 x NRP 4-1/2" x 4-1/2"	US26D	MK
1	Classroom Lock	45H7R 15H	626	BE
1	Door Stop	409	US32D	RO
3	Silencer	608		RO

Notes: EXISTING DOOR AND FRAME, NEW HARDWARE.

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows.
2. Doors.
3. Storefront framing.
4. Glazed entrances.
5. Interior borrowed lites.

B. Related Sections:

1. Division 08 Section "All-Glass Entrances and Storefronts."
2. Division 08 Section "Aluminum-Framed Entrances and Storefront."
3. Division 08 Section "Mirrors."

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit.

1.4 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:

1. Design Wind Pressures: As indicated on Drawings.
2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.

   a. Wind Design Data: As indicated on Drawings.
   b. Basic Wind Speed: 90 mph (40 m/s).

3. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
4. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
5. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than four Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.6 ACTION SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For glazing sealants used inside the weatherproofing system, documentation including printed statement of VOC content.

C. Glass Samples: For each type of; 12 inches (300 mm) square.

1. Tinted glass.
2. Coated glass.
3. Insulating glass.

D. Glazing Accessory Samples: For gaskets, sealants and colored spacers, in 12-inch (300-mm) lengths.

E. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

F. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installers, manufacturers of insulating-glass units with sputter-coated, low-e coatings, glass testing agency and sealant testing agency.

B. Product Certificates: For glass and glazing products, from manufacturer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for tinted glass, coated glass, insulating glass, glazing sealants and glazing gaskets.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Preconstruction adhesion and compatibility test report.

E. Warranties: Sample of special warranties.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

E. Source Limitations for Glass: Obtain tinted float glass, coated float glass and insulating glass from single source from single manufacturer for each glass type.

F. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

H. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

I. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F (250 deg C), and the fire-resistance rating in minutes.

J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

K. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F (4.4 deg C).

1.11 WARRANTY

A. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

1. Minimum Glass Thickness for Exterior Lites: Not less than 13.0 mm.
2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Windborne-Debris-Impact Resistance: Provide exterior glazing that passes basic-protection testing requirements in ASTM E 1996 for Wind Zone 1 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on the Project and shall be installed in same manner as glazing indicated for use on the Project.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located more than 30 feet (9.1 m) above grade.
3. Large-Missile Test: For all glazing, regardless of height above grade.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 13.0 mm thick.
2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

1. Basis-of-Design Product: Subject to compliance with requirements, provide PPG Clear or equivalent product.

B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
2. For uncoated glass, comply with requirements for Condition A.
3. For coated vision glass, comply with requirements for Condition C (other coated glass).

C. Uncoated Tinted Float Glass: Class 2, complying with other requirements specified.

1. Basis-of-Design Product: Subject to compliance with requirements, provide PPG Solarban 60 or equivalent product.

2. Tint Color: To match existing (Original) glazing.

2.3 INSULATING GLASS

A. Basis-of-Design Product: Subject to compliance with requirements, provide PPG Solarban 60 or equivalent product.

B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
2. Spacer: Manufacturer's standard spacer material and construction.
3. Desiccant: Molecular sieve or silica gel, or blend of both.

C. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Insulating-Glass Types" Article.

2.4 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. Neoprene complying with ASTM C 864.
2. EPDM complying with ASTM C 864.
3. Silicone complying with ASTM C 1115.
4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, EPDM, silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.5 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Sealants used inside the weatherproofing system, shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
4. Elastomeric Sealant Standard: Provide manufacturer’s standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements, including those for Type, Grade, Class and Uses.
5. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

2.6 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.8 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

2.9 MONOLITHIC-GLASS TYPES

A. Glass Type GL-1: Clear float glass.

1. Thickness: 6.0 mm.
2. Winter Nighttime U-Factor: 1.02 maximum.
3. Summer Daytime U-Factor: .93 maximum.
4. Solar Heat Gain Coefficient: .81 maximum.
5. Provide safety glazing labeling.

B. Glass Type GL-2: Clear fully tempered float glass.

1. Thickness: 6.0 mm.
2. Winter Nighttime U-Factor: .29 maximum.
3. Summer Daytime U-Factor: .27 maximum.
4. Solar Heat Gain Coefficient: .81 maximum.
5. Provide safety glazing labeling.

C. Glass Type GL-3: Tinted float glass.

1. Thickness: 6.0 mm.
2. Winter Nighttime U-Factor: .29 maximum.
3. Summer Daytime U-Factor: .27 maximum.

4. Solar Heat Gain Coefficient: .63 maximum.
5. Provide safety glazing labeling.

D. Glass Type GL-4: Tinted fully tempered float glass.

1. Thickness: 6.0 mm.
2. Winter Nighttime U-Factor: .29 maximum.
3. Summer Daytime U-Factor: .27 maximum.
4. Solar Heat Gain Coefficient: .63 maximum.
5. Provide safety glazing labeling.

E. Glass Type GL-5: Clear fully tempered float glass.

1. Thickness: 13.0 mm.
2. Provide safety glazing labeling.

2.10 INSULATING-GLASS TYPES

A. Glass Type IG-1: Low-e-coated, tinted insulating glass.

1. Overall Unit Thickness: 1 inch (25 mm).
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: Tinted float glass.
4. Interspace Content: Argon.
5. Indoor Lite: Clear float glass.
6. Low-E Coating: Sputtered on second or third surface.
7. Visible Light Transmittance: 34 percent minimum.
8. Winter Nighttime U-Factor: .29 maximum.
9. Summer Daytime U-Factor: .27 maximum.
10. Solar Heat Gain Coefficient: .32 maximum.
11. Provide safety glazing labeling.

B. Glass Type IG-2: Low-e-coated, tinted insulating glass.

1. Overall Unit Thickness: 1 inch (25 mm.
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: Tinted fully tempered float glass.
4. Interspace Content: Argon.
5. Indoor Lite: Clear fully tempered float glass.
6. Low-E Coating: Sputtered on second or third surface.
7. Visible Light Transmittance: 34 percent minimum.
8. Winter Nighttime U-Factor: .29 maximum.
9. Summer Daytime U-Factor: .27 maximum.
10. Solar Heat Gain Coefficient: .32 maximum.
11. Provide safety glazing labeling.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 LOCK-STRIP GASKET GLAZING

A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system unless otherwise indicated.

3.8 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

B. Related Requirements:

1. Division 05 Section "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

1.4 INFORMATION SUBMITTALS

A. Evaluation Reports: For dimpled steel studs and runners, from ICC-ES.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.

B. Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners.

1. Steel Studs and Runners:

a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
b. Depth: As indicated on Drawings.

2. Dimpled Steel Studs and Runners:

a. Minimum Base-Metal Thickness: 0.025 inch (0.64 mm).
b. Depth: As indicated on Drawings.

A. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.

3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

      1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
      2) MBA Building Supplies; FlatSteel Deflection Track.
      3) Steel Network Inc. (The); VertiClip SLD Series.
      4) Superior Metal Trim; Superior Flex Track System (SFT).
      5) Telling Industries; Vertical Slip Track.

A. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

   1. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).

B. Cold-Rolled Channel Bridging: Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

   1. Depth: 1-1/2 inches (38 mm).
   2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

C. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

   1. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
   2. Depth: As indicated on Drawings.

D. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.

   1. Configuration: hat shaped.

E. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

   1. Depth: As indicated on Drawings.
   2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (0.8 mm).
   3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

F. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.018 inch (0.45 mm), and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

C. Flat Hangers: Steel sheet, 1 by 3/16 inch (25 by 5 mm) by length indicated.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch (1.34 mm) and minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: 2 inches (51 mm).

E. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
2. Steel Studs and Runners: ASTM C 645.

a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
b. Depth: As indicated on Drawings.

3. Dimpled Steel Studs and Runners: ASTM C 645.

a. Minimum Base-Metal Thickness: 0.025 inch (0.64 mm).
b. Depth: As indicated on Drawings.

4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.

a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).

5. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.

a. Configuration: hat shaped.

F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Armstrong World Industries, Inc.; Drywall Grid Systems.
b. Chicago Metallic Corporation; Drywall Grid System.
c. USG Corporation; Drywall Suspension System.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (610 mm) o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.

2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.

1. Space studs as follows:

a. Single-Layer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
b. Multilayer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
c. Tile Backing Panels: 16 inches (406 mm) o.c. unless otherwise indicated.

C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

a. Install two studs at each jamb unless otherwise indicated.
b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

    a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:

    a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.

D. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

E. Z-Furring Members:

1. Erect insulation (specified in Division 07 Section "Thermal Insulation") vertically and hold in place with Z-furring members spaced 24 inches (610 mm) o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

   a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

B. Related Requirements:

1. Division 06 Section "Sheathing" for gypsum sheathing for exterior walls.
2. Division 09 Section "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.
3. Division 09 Section "Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured and regionally extracted and manufactured materials. Include statement indicating cost for each regionally manufactured material.

a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.

4. Product Data for Credit IEQ 4.1: For adhesives used to laminate gypsum board panels to substrates, documentation including printed statement of VOC content.

C. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.4 QUALITY ASSURANCE

A. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for the following:

a. Each level of gypsum board finish indicated for use in exposed locations.
b. Each texture finish indicated.

2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Low-Emitting Materials: For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Gypsum.
2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
4. Lafarge North America Inc.
5. National Gypsum Company.
6. PABCO Gypsum.
7. Temple-Inland.
8. USG Corporation.

B. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch (15.9 mm).
2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch (12.7 mm).
2. Long Edges: Tapered.

D. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch (15.9 mm), Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10.
4. Locations: Rooms 103, 104, 106, 107, 109, 110, 106, 146, and northwest wall of 141.

2.4 TILE BACKING PANELS

A. Water-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Gypsum.
b. CertainTeed Corp.
c. Georgia-Pacific Gypsum LLC.
d. Lafarge North America Inc.
e. PABCO Gypsum.
f. Temple-Inland.
g. USG Corporation.

2. Core: 5/8 inch (15.9 mm), Type X.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:

a. Cornerbead.

b. Bullnose bead.
c. LC-Bead: J-shaped; exposed long flange receives joint compound.
d. L-Bead: L-shaped; exposed long flange receives joint compound.
e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
f. Expansion (control) joint.
g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Fry Reglet Corp.
b. Gordon, Inc.
c. Pittcon Industries.

2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:

1. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
b. Grabber Construction Products; Acoustical Sealant GSC.
c. Pecora Corporation; AC-20 FTR.
d. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
e. USG Corporation; SHEETROCK Acoustical Sealant.

2. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Acoustical joint sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."

G. Vapor Retarder: As specified in Division 07 Section "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Wallboard Type: As indicated on Drawings.
2. Type X: As indicated on Drawings.
3. Ceiling Type: As indicated on Drawings.
4. Moisture- and Mold-Resistant Type: As indicated on Drawings.
5. Glass-Mat Interior Type: As indicated on Drawings.
6. Acoustically Enhanced Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 APPLYING TILE BACKING PANELS

A. Water-Resistant Backing Board: Install where indicated with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.
3. Curved-Edge Cornerbead: Use at curved openings.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 3: Where indicated on Drawings.
4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

    a. Primer and its application to surfaces are specified in other Division 09 Sections.

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Ceramic tile.
2. Stone thresholds.
3. Crack isolation membrane.
4. Metal edge strips.

B. Related Sections:

1. Division 07 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."

C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1. Level Surfaces: Minimum 0.8

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
2. Product Data for Credit IEQ 4.3: For adhesives and grouts, documentation including printed statement of VOC content.
3. Product Data for Credit IEQ 4.3: For tile floors, documentation from an independent testing agency indicating compliance with the FloorScore Standard.

C. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

D. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

E. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches (300 mm) square, but not fewer than 4 tiles. Use grout of type and in color or colors approved for completed Work.
3. Full-size units of each type of trim and accessory for each color and finish required.
4. Stone thresholds in 6-inch (150-mm) lengths.
5. Metal edge strips in 6-inch (150-mm) lengths.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: For each type of product, signed by product manufacturer.

D. Material Test Reports: For each tile-setting and -grouting product and special purpose tile.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.8 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:

1. Stone thresholds.
2. Crack isolation membrane.
3. Joint sealants.
4. Metal edge strips.

D. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.

C. FloorScore Compliance: Tile for floors shall comply with requirements of FloorScore Standard.

D. Low-Emitting Materials: Tile flooring systems shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

F. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

1. Where tile is indicated for installation, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

G. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 TILE PRODUCTS

A. Tile Type CT-1: Unglazed floor tile.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Crossville Inc. or comparable product.
2. The terms "porcelain" and "natural clay" describe the basic material that the tile is made of and have nothing to do with color. See Evaluations. Note that if a manufacturer does not state that the tile is porcelain, it probably is not.
3. Composition: Porcelain.
4. Face Size: 12 by 12 inches (297 by 297 mm).
5. Thickness: 13/32 inch (10.5 mm).
6. Face: Plain with cushion edges.
7. Finish: Mat, clear glaze.
8. Tile Color and Pattern: Color Blox EC, Roasted Marshmallow (E1102).
9. Grout Color: As selected by Architect from manufacturer's full range.
10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

    a. Base Cove (CT-3): Cove, module size 6”x12”.
    b. External Corners for Thin-Set Mortar Installations: Surface bullnose, module size same as adjoining flat tile.
    c. Internal Corners: Cove, module size same as adjoining flat tile.
    d. Internal Corners: Field-butted square corners. For coved base and cap, use angle pieces designed to fit with stretcher shapes.
    e. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch (12.7 to 6.35 mm) across nominal 4-inch (100-mm) dimension.

B. Tile Type CT-2: Porcelain wall tile.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Crossville Inc. or comparable product.
2. Module Size: 6 by 6 inches (147 by 147 mm).
3. Thickness: 13/32 inch (10.5 mm).
4. Face: Plain with cushion edges.
5. Finish: Mat, opaque.
6. Grout Color: As selected by Architect from manufacturer's full range.
7. Mounting: Factory, back mounted.
8. Mounting: Pregrouted sheets of tiles factory assembled and grouted with manufacturer's standard white silicone rubber.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

    a. Base for Thin-Set Mortar Installations:
    b. Wainscot Cap (CT-4) for Thin-Set Mortar Installations: Surface bullnose, module size 4 by 12 inches (95 by 298 mm).
    c. External Corners for Thin-Set Mortar Installations: Surface bullnose, same size as adjoining flat tile.
    d. Internal Corners: Field-butted square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.

10. Tile Color and Pattern: Color Blox EC, Roasted Marshmallow (E1102).

2.3 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch (12.7 mm) or less above adjacent floor surface.

B. Marble Thresholds: ASTM C 503, with a minimum abrasion resistance of [**10**] [**12**] per ASTM C 1353 or ASTM C 241 and with honed finish.

1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.4 CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

2.5 SETTING MATERIALS

A. Thin-Set Portland Cement Mortar: Where thin-set portland cement mortar applications are indicated, use the following unless otherwise required.
1. Dry-set portland cement mortar, ANSI A118.1, factory sanded.

B. Latex-Portland Cement Mortar: ANSI A118.4, composition as follows:
1. Prepackaged dry mortar mix composed of portland cement, graded aggregate, and the following dry polymer additive in the form of a re-emulsifiable powder to which only water is added at job site.
   a. Dry Polymer Additive: Manufacturer's standard.
2. Latex additive (water emulsion) of type described below, serving as replacement for part or all of gauging water, combined at job site with prepackaged dry mortar mix supplied or specified by latex additive manufacturer.
   a. Latex Type: Manufacturer's standard.

2.6 GROUTING MATERIALS

A. Commercial Portland Cement Grout: ANSI A118.6, color as selected from manufacturer’s full line.

B. Dry-Set Grout: ANSI A118.6, color as selected from manufacturer’s full line.

2.7 ELASTOMERIC SEALANTS

A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer indicated that comply with requirements of Division 7 Section "Joint Sealers," including ASTM C 920 as referenced by Type, Grade, Class, and Uses.

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

C. Multipart Pourable Urethane Sealant for Use T: Type M; Grade P; Class 25; Use T.

2.8 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with requirements of referenced standards and manufacturers including those for accurate proportioning of materials, water, or additive content; type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortars and grouts of uniform quality with optimum performance characteristics for application indicated.

2.9 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Temporary Protective Coating: Either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.

1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F (49 to 60 deg C) per ASTM D 87.
2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

D. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Bonsal American; an Oldcastle company; Grout Sealer.
b. Bostik, Inc.; CeramaSeal Grout & Tile Sealer.
c. C-Cure; Penetrating Sealer 978.

d. Custom Building Products; Grout and Tile Sealer.
e. Jamo Inc.; Matte Finish Sealer.
f. MAPEI Corporation; KER 004, Keraseal Penetrating Sealer for Unglazed Grout and Tile.
g. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer.
h. Summitville Tiles, Inc.; SL-15, Invisible Seal Penetrating Grout and Tile Sealer.
i. TEC; a subsidiary of H. B. Fuller Company; TA-256 Penetrating Silicone Grout Sealer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

   a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
   b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 TILE INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Ceramic Mosaic Tile: 1/16 inch (1.6 mm).
2. Paver Tile: 1/4 inch (6.35 mm).
3. Glazed Wall Tile: 1/16 inch (1.6 mm).
4. Decorative Thin Wall Tile: 1/16 inch (1.6 mm).

G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thin set).
2. Do not extend crack isolation membrane under thresholds set in dry-set portland cement or latex-portland cement mortar. Fill joints between such thresholds and adjoining tile set on crack isolation membrane with elastomeric sealant.

J. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors]according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

3.5 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove latex-portland cement grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION 093000

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for ceilings.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
2. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.

C. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.

D. Samples for Initial Selection: For components with factory-applied color finishes.

E. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.

2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- (150-mm-) long Samples of each type, finish, and color.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which suspension systems will be attached.
3. Size and location of initial access modules for acoustical panels.
4. Items penetrating finished ceiling including the following:

   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.

5. Perimeter moldings.

B. Qualification Data: For testing agency.

C. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
3. Hold-Down Clips: Equal to 2 percent of quantity installed.
4. Impact Clips: Equal to 2 percent of quantity installed.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.

B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of typical ceiling area as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
2. Smoke-Developed Index: 50 or less.

C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ACOUSTICAL PANELS, GENERAL

A. Low-Emitting Materials: Acoustical panel ceilings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.

C. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 70 percent.

D. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.

E. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface according to ASTM E 795.

F. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 ACOUSTICAL PANELS ACP1

A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries Ultima Open Plan #1941 or comparable product.

B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:

1. Type and Form: Type IV, mineral fiber with painted finish; Form 2.

2. Pattern: E (lightly textured).

C. Color: White.

D. LR: Not less than 0.89.

E. NRC: Not less than 0.75.

F. Edge/Joint Detail: Beveled Tegular.

G. Thickness: 3/4 inch (19 mm).

H. Modular Size: 24 by 24 inches (610 by 610 mm).

I. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

   a. Type: Postinstalled bonded anchors.
   b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
   c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.

d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
4. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch- (3.5-mm-) diameter wire.

E. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.

F. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

H. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.

I. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees.

J. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.5 METAL SUSPENSION SYSTEM

A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries Prelude 15/16” Exposed Tee Grid or comparable product.

B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip

galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.

1. Structural Classification: Intermediate-duty system.
2. End Condition of Cross Runners: Override (stepped) type.
3. Face Design: Flat, flush.
4. Cap Material: Aluminum cold-rolled sheet.
5. Cap Finish: Painted white.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries Prelude or comparable product.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.7 ACOUSTICAL SEALANT

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1. Acoustical Sealant for Exposed and Concealed Joints:

   a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
   b. USG Corporation; SHEETROCK Acoustical Sealant.

2. Acoustical Sealant for Concealed Joints:

   a. Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.
   b. Pecora Corporation; AIS-919.
   c. Tremco, Inc.; Tremco Acoustical Sealant.

B. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.
2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant.
3. Acoustical sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical panels as follows:

a. As indicated on reflected ceiling plans.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
6. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions unless otherwise indicated.
7. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Compliance of seismic design.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.

1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.

a. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.

b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

D. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient base.
2. Resilient molding accessories.

B. Related Sections:

1. Division 09 Section "Resilient Tile Flooring" for resilient floor tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Samples for Initial Selection: For each type of product indicated.

D. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

E. Product Schedule: For resilient products.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Mockups: Provide resilient products with mockups specified in other Sections.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.7 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE RWB-01

A. Resilient Base:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Johnsonite or comparable product.

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TV (vinyl, thermoplastic.
2. Manufacturing Method: Group I (solid, homogeneous.
3. Style: Cove (base with toe.

C. Minimum Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches (102 mm).

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Preformed.

G. Inside Corners: Job formed.

H. Finish: Matte.

I. Colors and Patterns: Storm Cloud #71.

2.2 RESILIENT MOLDING ACCESSORY

A. Resilient Molding Accessory:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
b. Flexco, Inc.
c. Johnsonite.
d. R.C.A. Rubber Company (The).
e. Roppe Corporation, USA.
f. VPI, LLC; Floor Products Division.

B. Description:
1. Reducer or transition strip
a. CPT to LVT
b. CPT to VCT
c. CPT to CONC
d. CPT to Existing

C. Material: Vinyl.

D. Profile and Dimensions: As required per material.

E. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24.
2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

D. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

2.4 RESILIENT BASE RWB-02

A. Resilient Base:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Johnsonite or comparable product.

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TV (vinyl, thermoplastic.
2. Manufacturing Method: Group I (solid, homogeneous.
3. Style: Cove (base with toe.

C. Minimum Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches (102 mm).

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Preformed.

G. Inside Corners: Job formed.

H. Finish: Matte.

I. Colors and Patterns: Greege #190.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Treads and Accessories: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
4. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

   a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
   b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
2. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Stair Accessories:

1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
2. Tightly adhere to substrates throughout length of each piece.
3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and resilient floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.

1. Apply three coat(s).

E. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vinyl composition floor tile.

2. Luxury Vinyl Tile

B. Related Sections:

1. Division 09 Section "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives sealants and chemical-bonding compounds, documentation including printed statement of VOC content.
2. Product Data for Credit IEQ 4.3: For adhesives and chemical-bonding compounds, documentation including printed statement of VOC content.
3. Product Data for Credit IEQ 4.3: For resilient tile flooring, documentation from an independent testing agency indicating compliance with the FloorScore Standard.

C. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

D. Samples for Initial Selection: For each type of floor tile indicated.

E. Samples for Verification: Full-size units of each color and pattern of floor tile required.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches (230 mm) long, of each color required.

F. Seam Samples: For seamless-installation technique indicated and for each flooring product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch (150-by-230-mm) Sample applied to a rigid backing and prepared by Installer for this Project.

G. Product Schedule: For floor tile.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 MATERIALS MAINTENANCE SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.

B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups for floor tile including resilient base and accessories.

a. Size: Minimum 100 sq. ft. (9.3 sq. m) for each type, color, and pattern.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.9 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. FloorScore Compliance: Resilient tile flooring shall comply with requirements of FloorScore Standard.

B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 VINYL COMPOSITION FLOOR TILE VCT-1

A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries or comparable product.

B. Tile Standard: ASTM F 1066, Class 2, through-pattern tile.

C. Wearing Surface: Smooth.

D. Thickness: 0.125 inch (3.2 mm).

E. Size: 12 by 12 inches (305 by 305 mm).

F. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 LUXURY VINYL FLOOR TILE LVT-1

A. Basis-of-Design Product: Subject to compliance with requirements, provide Centiva or comparable product.

B. Tile Standard: ASTM F 1700, Class 3, solid vinyl tile.

C. Pattern: Contour Plank

D. Wearing Surface: Tick (TK).

E. Thickness: 0.12 inch (3 mm).

F. Size: 4 by 36 inch plank.

G. Colors: Hawaiian Teak CP 3311-C TK.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

1. Adhesives shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. VCT and Asphalt Tile Adhesives: Not more than 50 g/L.

2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are same temperature as space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

   1. Lay tiles square with room axis.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

   1. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.

B. Perform the following operations immediately after completing floor tile installation:

   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Sweep and vacuum surfaces thoroughly.
   3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.

   1. Apply three coat(s).

E. Joint Sealant: Apply sealant to resilient terrazzo floor tile perimeter and around columns, at door frames, and at other joints and penetrations.

F. Sealers and Finish Coats: Remove soil, visible adhesive, and surface blemishes from resilient terrazzo floor tile surfaces before applying liquid cleaners, sealers, and finish products.

   1. Sealer: Apply two base coats of liquid sealer.
   2. Finish: Apply three coats of liquid floor finish.

G. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes modular, tip sheared pattern loop carpet tile.

B. Related Requirements:

1. Division 02 Section "Selective Structure Demolition" for removing existing floor coverings.
2. Division 09 Section "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.
3. Division 09 Section "Sheet Carpeting."

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:

a. Review delivery, storage, and handling procedures.
b. Review ambient conditions and ventilation procedures.
c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include installation recommendations for each type of substrate.

B. LEED Submittals:

1. Product Data for Credit EQ 4.3:

a. For carpet tile, documentation indicating compliance with testing and product requirements of CRI's "Green Label Plus" program.
b. For installation adhesive, documentation including printed statement of VOC content.

C. Shop Drawings: Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

D. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

F. Sustainability: Provide the Statement of the Achievement Level the carpet has attained for Silver, 37 to 51 points, based on specific Sustainable Attribute Performance for all product stages according to ANSI/NSF 140.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups at locations and in sizes shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

1.10 FIELD CONDITIONS

A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.11 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, excess static discharge, loss of tuft bind strength, loss of face fiber, loss of moisture barrier, color loss from bleach spills, staining and delamination.
3. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE CPT-2

A. Basis-of-Design Product: Subject to compliance with requirements, provide Mannington Commercial or comparable product available for purchase through State of Delaware Contract.

B. Color: Mint Lime 4206.

C. Pattern: Capstone.

D. Fiber Content: Invista Antron Legacy type 6,6 nylon.

E. Pile Characteristic: Pattern loop.

F. Pile Thickness: 0.114 inches.

G. Stitches: .114 stitches per inch.

H. Gage: 1/12 ends per inch.

I. Face Weight: 20 oz./sq. yd.

J. Primary Backing: 100% Woven Synthetic.

K. Secondary Backing: Infinity RE reinforced composite closed cell polymer with recycled content.

L. Size: 24 by 24 inches.

M. Applied Soil-Resistance Treatment: Manufacturer's standard material.

N. Antimicrobial Treatment: Manufacturer's standard material.

O. Performance Characteristics: As follows:

1. Appearance Retention Rating: Heavy traffic, 3.0 minimum per ASTM D 7330.
2. Dry Breaking Strength: Not less than 100 lbf (445 N) per ASTM D 2646.
3. Resistance to Insects: Comply with AATCC 24.
4. Colorfastness to Crocking: Not less than 4, wet and dry, per AATCC 165.
5. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) per AATCC 16, Option E.
6. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria; not less than 1-mm halo of inhibition for gram-negative bacteria; no fungal growth; per AATCC 174.
7. Electrostatic Propensity: Less than 3.0 kV according to AATCC 134.
8. Emissions: Provide carpet tile that complies with testing and product requirements of CRI's "Green Label Plus" program.
9. Emissions: Provide carpet tile that complies with the product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 CARPET TILE EM-1

A. Basis-of-Design Product: Subject to compliance with requirements, provide Mannington Commercial or comparable product.

B. Color: As selected by Architect from manufacturer's full range.

C. Pattern: Traverse Walk Off Tile

D. Fiber Content: 100 percent nylon 6, 6.

E. Fiber Type:

F. Pile Characteristic: Tip Shear loop pile.

G. Pile Thickness: 0.142 inches for finished carpet tile.

H. Stitches: 9 stitches per inch.

I. Gage: 5/32 per inch.

J. Total Weight: 38 oz./sq. yd. for finished carpet tile.

K. Primary Backing/Backcoating: 100% Woven Synthetic.

L. Secondary Backing: Infinity RE Modular Reinforced Composite Closed Cell Polymer with Recycled Content.

M. Size: 24 by 24 inches.

N. Applied Soil-Resistance Treatment: Manufacturer's standard material.

O. Antimicrobial Treatment: Manufacturer's standard material.

P. Performance Characteristics: As follows:

1. Appearance Retention Rating: Heavy traffic, 3.0 minimum according to ASTM D 7330.
2. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
3. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
4. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
5. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) according to AATCC 16, Option E.
6. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.
7. Electrostatic Propensity: Less than 3.0 kV according to AATCC 134.
8. Emissions: Provide carpet tile that complies with testing and product requirements of CRI's "Green Label Plus" program.
9. Emissions: Provide carpet tile that complies with the product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Metal Edge/Transition Strips: Extruded aluminum with [**mill**] <**Insert finish**> finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. For wood subfloors, verify the following:

1. Underlayment over subfloor complies with requirements specified in Division 06 Section "Rough Carpentry."
2. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

D. For metal subfloors, verify the following:

1. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

E. For painted subfloors, verify the following:

1. Perform bond test recommended in writing by adhesive manufacturer.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks,

holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer.

C. Maintain dye lot integrity. Do not mix dye lots in same area.

D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

G. Install pattern parallel to walls and borders.

H. Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 096816 - SHEET CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Tufted carpet.
2. Woven carpet.
3. Carpet cushion.

B. Related Requirements:

1. Division 02 Section "Selective Structure Demolition" for removing existing floor coverings.
2. Division 09 Section "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet.
3. Division 09 Section "Tile Carpeting."

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to carpet installation including, but not limited to, the following:

a. Review delivery, storage, and handling procedures.
b. Review ambient conditions and ventilation procedures.
c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For the following, including installation recommendations for each type of substrate:

1. Carpet: For each type indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance.

2. Carpet Cushion: For each type indicated. Include manufacturer's written data on physical characteristics and durability.

B. LEED Submittals:

1. Product Data for Credit EQ 4.3:

a. For carpet, documentation indicating compliance with testing and product requirements of CRI's "Green Label Plus" program.
b. For carpet cushion, documentation indicating compliance with testing and product requirements of CRI's "Green Label" program.
c. For installation adhesive, including printed statement of VOC content.

C. Shop Drawings: Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
2. Carpet type, color, and dye lot.
3. Locations where dye lot changes occur.
4. Seam locations, types, and methods.
5. Type of subfloor.
6. Type of installation.
7. Pattern type, repeat size, location, direction, and starting point.
8. Pile direction.
9. Type, color, and location of insets and borders.
10. Type, color, and location of edge, transition, and other accessory strips.
11. Transition details to other flooring materials.
12. Type of carpet cushion.

D. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet: 12-inch- (300-mm-) square Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.
3. Carpet Cushion: 6-inch- (150-mm-) square Sample.
4. Carpet Seam: 6-inch (150-mm) Sample.
5. Mitered Carpet Border Seam: 12-inch- (300-mm-) square Sample. Show carpet pattern alignment.

E. Product Schedule: For carpet and carpet cushion. Use same designations indicated on Drawings.

F. Sustainability: Provide the Statement of the Achievement Level the carpet has attained for Silver, 37 to 51 points, based on specific Sustainable Attribute Performance for all product stages according to ANSI/NSF 140.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Test Reports: For carpet and carpet cushion, for tests performed by a qualified testing agency.

C. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet and carpet cushion.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet: Full-width rolls equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An experienced Installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

B. Fire-Test-Response Ratings: Where indicated, provide carpet and carpet cushion identical to those of assemblies tested for fire response per NFPA 253 by a qualified testing agency.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups at locations and in sizes shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

1.10 FIELD CONDITIONS

A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet and carpet cushion until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.

C. Do not install carpet and carpet cushion over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

1.11 WARRANTY

A. Special Warranty for Carpet: Manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, excess static discharge, loss of moisture barrier, color loss from bleach spills, staining and delamination.
3. Warranty Period: 15 years from date of Substantial Completion.

B. Special Warranty for Carpet Cushion: Manufacturer agrees to repair or replace components of carpet cushion installation that fail in materials or workmanship within specified warranty period.

1. Warranty includes consequent removal and replacement of carpet and accessories.
2. Warranty does not include deterioration or failure of carpet cushion due to unusual traffic, failure of substrate, vandalism, or abuse.
3. Failure includes, but is not limited to, permanent indentation or compression.
4. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TUFTED CARPET CPT-1

A. Basis-of-Design Product: Product: Subject to compliance with requirements, provide Mannington Commercial or comparable product available for purchase through State of Delaware Contract.

B. Color: Mint Lime 4206

C. Pattern: Carthage Brights.

D. Fiber Content: Invista Antron Legacy.

E. Fiber Type: Invista Antron Legacy.

F. Pile Characteristic: Graphic loop pile.

G. Pile Thickness: 0.108 inches for finished carpet.

H. Stitches: 10.0 stitches per inch.

I. Gage: 1/10 ends per inch .

J. Face Weight: 20 oz./sq. yd.

K. Primary Backing: 100% Synthetic

L. Secondary Backing: UltraBac RE with 10% recycled content and lifetime warranty.

M. Width: 12 feet.

N. Applied Soil-Resistance Treatment: Manufacturer's standard material.

O. Antimicrobial Treatment: Manufacturer's standard material.

P. Performance Characteristics: As follows:

1. Appearance Retention Rating: Heavy traffic, 3.0 minimum per ASTM D 7330.
2. Dry Breaking Strength: Not less than 100 lbf (445 N) per ASTM D 2646.
3. Resistance to Insects: Comply with AATCC 24.
4. Colorfastness to Crocking: Not less than 4, wet and dry, per AATCC 165.
5. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) per AATCC 16, Option E.
6. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria; not less than 1-mm halo of inhibition for gram-negative bacteria; no fungal growth; per AATCC 174.
7. Electrostatic Propensity: Less than 3.0 kV per AATCC 134.
8. Emissions: Provide carpet that complies with testing and product requirements of CRI's "Green Label Plus" program.
9. Emissions: Provide carpet that complies with the product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 TUFTED CARPET CPT-3

A. Basis-of-Design Product: Subject to compliance with requirements, provide Dixie Home or comparable product.

B. Color: As selected by Architect from manufacturer's full range

C. Pattern: Penley Estates 2478.

D. Fiber Content: 100 percent nylon 6.

E. Fiber Type: Stainmaster Luxerell.

F. Pile Characteristic: Cut pile.

G. Yarn Twist: 5.75 TPI.

H. Pile Height: 17/32 inches.

I. Primary Backing: polypropylene.

J. Secondary Backing: ActionBac.

K. Width: 12 feet (3.7 m).

L. Applied Soil-Resistance Treatment: Manufacturer's standard material.

M. Antimicrobial Treatment: Manufacturer's standard material.

2.3 TUFTED CARPET CPT-4

A. Not Used.

2.4 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet manufacturer.

1. Use adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use adhesives that comply with the product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Tackless Carpet Stripping: Water-resistant plywood, in strips as required to match cushion thickness and that comply with CRI 104, Section 12.2.

D. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

E. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

2.5 TUFTED CARPET CPT-5

A. Basis-of-Design Product: Subject to compliance with requirements, provide Kraus, Inc. or comparable product.

B. Color: Kiwi (04)

C. Pattern: @Work Conference (1804).

D. Fiber Content: 100% nylon

E. Pile Characteristic: pattern cut pile graphics.

F. Pile Thickness: 0.19 inches for finished carpet.

G. Stitches: 8.2 stitches per inch.

H. Gage: 1/10 ends per inch.

I. Face Weight: 28 oz./sq. yd.

J. Density: 7.5 kilotex/sq. cm.

K. Primary Backing: Dual Bonded Woven Synthetic

L. Applied Soil-Resistance Treatment: Manufacturer's standard material.

M. Antimicrobial Treatment: Manufacturer's standard material.

N. Performance Characteristics: As follows:
1. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) per AATCC 16, Option E.
2. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria; not less than 1-mm halo of inhibition for gram-negative bacteria; no fungal growth; per AATCC 174.
3. Electrostatic Propensity: Less than 3.0 kV per AATCC 134.

4. Emissions: Provide carpet that complies with testing and product requirements of CRI's "Green Label Plus" program.

2.6 TUFTED CARPET CPT-6

A. Basis-of-Design Product: Subject to compliance with requirements, provide Shaw/Philadelphia Commercial or comparable product.

B. Color: Seagrass (65370)

C. Pattern: Baytowne III 36 (J0065).

D. Fiber Content: nylon

E. Pile Characteristic: cut pile.

F. Pile Thickness: 0.22 inches for finished carpet.

G. Stitches: 10 stitches per inch.

H. Gage: 1/10 ends per inch .

I. Face Weight: 36 oz./sq. yd.

J. Density 10.97 Kilotex/sq. cm.

K. Primary Backing: Synthetic

L. Secondary Backing: Classicbac

M. Width: 12 feet.

N. Applied Soil-Resistance Treatment: Manufacturer's standard material.

O. Antimicrobial Treatment: Manufacturer's standard material..

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet[**cushion**] manufacturer.
2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. For wood subfloors, verify the following:

1. Underlayment over subfloor complies with requirements specified in Division 06 Section "Rough Carpentry."
2. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI 104, Section 7.3, "Site Conditions; Floor Preparation," and with carpet manufacturer's written installation instructions for preparing substrates.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet[**cushion**] manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

3.3 INSTALLATION

A. Comply with CRI 104 and carpet manufacturer's written installation instructions for the following:

1. Direct-Glue-Down Installation: Comply with CRI 104, Section 9, "Direct Glue-Down Installation."

B. Comply with carpet manufacturer's written recommendations and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.

C. Do not bridge building expansion joints with carpet.

D. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.

E. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

G. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, "Patterned Carpet Installations" and with carpet manufacturer's written recommendations.

3.4 CLEANING AND PROTECTING

A. Perform the following operations immediately after installing carpet:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
2. Remove yarns that protrude from carpet surface.
3. Vacuum carpet using commercial machine with face-beater element.

B. Protect installed carpet to comply with CRI 104, Section 16, "Protecting Indoor Installations."

C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer.

END OF SECTION 096816

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on interior substrates.

B. Related Requirements:

1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
2. Division 06 Sections for shop priming carpentry with primers specified in this Section.
3. Division 09 Section "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.

1.3 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. LEED Submittals:

1. Product Data for Credit EQ 4.2: For paints and coatings, including printed statement of VOC content.

C. Samples for Initial Selection: For each type of topcoat product.

D. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

E. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
3. VOC content.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

   a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Behr Process Corporation.
2. Benjamin Moore & Co.
3. Benjamin Moore & Co. (Canada).
4. Bennette Paint Manufacturing Company, Inc.
5. Betonel Ltd.
6. BLP Mobile Paint Manufacturing.
7. California Paints.
8. Cloverdale Paint.
9. Color Wheel Paints & Coatings.
10. Columbia Paint & Coatings.

11. Conco Paints.
12. Coronado Paint.
13. Davis Paint Company.
14. Diamond Vogel Paints.
15. Dunn-Edwards Corporation.
16. Durant Performance Coatings.
17. Duron, Inc.
18. Envirocoatings Canada Inc.
19. Euclid Chemical Company.
20. Farrell-Calhoun.
21. Frazee Paint.
22. General Paint.
23. Hallman Lindsay Paints.
24. Hirshfield's, Inc.
25. ICI Paints.
26. ICI Paints (Canada).
27. Insl-x.
28. Kelly-Moore Paints.
29. Kwal Paint.
30. M.A.B. Paints.
31. McCormick Paints.
32. Microblend Technologies Inc.
33. Miller Paint.
34. Mills Paint.
35. PARA Paints.
36. Parex LaHabra Inc.
37. Parker Paint Mfg. Co. Inc.
38. PPG Architectural Finishes, Inc.
39. Pratt & Lambert.
40. Rodda Paint Co.
41. Scott Paint.
42. Sherwin-Williams Company (The).
43. Sico, Inc.
44. Southern Diversified Products, LLC.
45. Smith Paint Products.
46. Vista Paint.
47. Zinsser.

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in other Part 2 articles for the paint category indicated.

2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.

D. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Colors: As designated on drawings and schedules.

2.3 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

1. VOC Content: E Range of E2.
2. Basis of Design Product: Harmony Interior Latex Primer by Sherwin Williams Company

2.4 METAL PRIMERS

A. Universal Water Based Primer: SSPC-Paint 24.

1. VOC Content: E Range of E1.
2. Basis of Design Product: Pro-Cryl (B66-310 Series) by Sherwin Williams Company

2.5 WOOD PRIMERS

A. Interior Latex-Based Wood Primer: MPI #39.

1. VOC Content: E Range of E2.
2. Basis of Design Product: PrepRite 200 Interior Latex Primer by Sherwin Williams Company.

2.6 LATEX PAINTS

A. Institutional Low-Odor/VOC Latex (Eggshell): MPI #145 (Gloss Level 3).

1. VOC Content: E Range of E3.
2. Basis of Design Product: Harmony Low Odor Interior Latex by Sherwin Williams Company

B. Institutional Low-Odor/VOC Latex (Semigloss): MPI #147 (Gloss Level 5).

1. VOC Content: E Range of E3.
2. Basis of Design Product: Harmony Low Odor Interior Latex by Sherwin Williams Company

2.7 FLOOR COATINGS

A. Interior/Exterior Clear Concrete Floor Sealer (Water Based): MPI #99.

1. VOC Content: E Range of E2

2.8 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMU): 12 percent.
3. Wood: 15 percent.
4. Gypsum Board: 12 percent.
5. Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Plaster Substrates: Verify that plaster is fully cured.

E. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.

F. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

G. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer**.**

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Aluminum Substrates: Remove loose surface oxidation.

J. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

   a. Equipment, including panelboards and switch gear.
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Plastic conduit.
   g. Tanks that do not have factory-applied final finishes.
   h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

2. Paint the following work where exposed in occupied spaces:

   a. Equipment, including panelboards.
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Plastic conduit.
   g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   h. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Traffic Surfaces:

1. Water-Based Clear Sealer System: MPI INT 3.2G.

a. First Coat: Interior/exterior clear concrete floor sealer (water based).
b. Topcoat: Interior/exterior clear concrete floor sealer (water based).

B. Steel Substrates:

1. Institutional Low-Odor/VOC Latex System: MPI INT 5.1S.

a. Prime Coat: Rust-inhibitive primer (water based).
b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
c. Topcoat: Institutional low-odor/VOC interior latex (semigloss).

C. Galvanized-Metal Substrates:

1. Water-Based Dry-Fall System: MPI INT 5.3H.

a. Prime Coat: Waterborne dry fall.
b. Topcoat: Waterborne dry fall.

2. Institutional Low-Odor/VOC Latex System: MPI INT 5.3N.

a. Prime Coat: Waterborne galvanized-metal primer.
b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
c. Topcoat: Institutional low-odor/VOC interior latex (semigloss).

D. Wood (Opaque finish):

1. Institutional Low-Odor/VOC Latex System:

a. Prime Coat: Interior latex primer/sealer for WOOD.
b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
c. Topcoat: Institutional low-odor/VOC interior latex (eggshell).

E. Wood (Natural finish):

1. Institutional Low-Odor/VOC polyurethane system:

a. Prime Coat: Interior latex primer/sealer.
b. Filler Coat: Institutional low-odor/VOC paste wood filler.
c. Intermediate Coat: Institutional low-odor/VOC urethane matching topcoat.
d. Topcoat: Institutional low-odor/VOC urethane (gloss).

F. Gypsum Board Substrates:

1. Institutional Low-Odor/VOC Latex System: MPI INT 9.2M.

a. Prime Coat: Interior latex primer/sealer.
b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
c. Topcoat: Institutional low-odor/VOC interior latex eggshell.

END OF SECTION 099123

SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and application of wood finishes**.**

B. Related Requirements:

1. Division 09 wood flooring Sections for stains and transparent finishes applied to wood flooring.
2. Division 09 Section "Interior Painting" for stains and transparent finishes on concrete floors.

1.3 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

D. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

E. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.

B. LEED Submittals:

1. Product Data for Credit EQ 4.2: For interior stains and coatings, documentation including printed statement of VOC content.

C. Samples for Initial Selection: For each type of product indicated.

D. Samples for Verification: For each type of finish system and in each color and gloss of finish indicated.

1. Submit Samples on representative samples of actual wood substrates, 8 inches (200 mm) square or 8 inches (200 mm) long.
2. Label each Sample for location and application area.

E. Product List: For each product indicated, include the following:

1. Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the product proposed for use highlighted.
3. VOC content.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Stains and Transparent Finishes: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of stain color selections will be based on mockups.

a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply finishes when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

C. Do not apply exterior finishes in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Behr Process Corporation.
2. Benjamin Moore & Co.
3. Benjamin Moore & Co. (Canada).
4. Bennette Paint Mfg. Co., Inc.
5. BLP Mobile Paint Manufacturing.
6. California Paints.
7. Cloverdale Paint.
8. Color Wheel Paints & Coatings.
9. Columbia Paint & Coatings.
10. Conco Paints.
11. Coronado Paint.
12. Davis Paint Company.
13. Diamond Vogel Paints.
14. Dunn-Edwards Corporation.
15. Durant Paints Inc.
16. Duron, Inc.
17. Euclid Chemical Company.
18. Farrell-Calhoun.
19. Frazee Paint.
20. General Paint.

21. Hallman Lindsay Paints.
22. Hirshfield's, Inc.
23. ICI Paints.
24. ICI Paints (Canada).
25. Insl-x.
26. Kelly-Moore Paints.
27. Kwal Paint.
28. Life Paint Corp.
29. M.A.B. Paints.
30. McCormick Paints.
31. Miller Paint.
32. Mills Paint.
33. PARA Paints.
34. Parex LaHabra Inc.
35. Parker Paint Mfg. Co. Inc.
36. PPG Architectural Finishes, Inc.
37. Pratt & Lambert.
38. Rodda Paint Co.
39. SaverSystems.
40. Sherwin-Williams Company (The).
41. Sico, Inc.
42. Target Coatings.
43. Vista Paint.
44. Zinsser.

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in other Part 2 articles for the category indicated.

2.2 MATERIALS, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each finish system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a finish system, provide products recommended in writing by manufacturers of topcoat for use in finish system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior stains and finishes applied at project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
2. Shellacs, Clear: VOC not more than 730 g/L.
3. Stains: VOC not more than 250 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.

D. Low-Emitting Materials: Interior stains and finishes shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Stain Colors: As selected by Architect from manufacturer's full range.

2.3 SOURCE QUALITY CONTROL

A. Testing of Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample wood finishing materials. Contractor will be notified in advance and may be present when samples are taken. If materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying wood finishes if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying materials from Project site, pay for testing, and refinish surfaces finished with rejected materials. Contractor will be required to remove rejected materials from previously finished surfaces before refinishing with complying materials if the two finishes are incompatible or produce results that, in the opinion of the Architect, are aesthetically unacceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Interior Wood Substrates: 13 percent, when measured with an electronic moisture meter.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with finish application only after unsatisfactory conditions have been corrected.

1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.

1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

D. Exterior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Prime edges, ends, faces, undersides, and backsides of wood.

a. For solid hide stained wood, stain edges and ends after priming.
b. For varnish coated stained wood, stain edges and ends and prime with varnish. Prime undersides and backsides with varnish.

3. Countersink steel nails, if used, and fill with putty or plastic wood filler tinted to final color. Sand smooth when dried.

E. Interior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.
3. Sand surfaces that will be exposed to view and dust off.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for finish and substrate indicated.
2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood substrates, nontraffic surfaces, including wood trim, architectural woodwork, doors and frames.

1. Semitransparent Stain System:

   a. Prime Coat: Stain, semi-transparent, matching topcoat.
   b. Topcoat: Stain, semi-transparent, for interior wood.

2. Polyurethane Varnish over Stain System:

   a. Stain Coat: Stain, semi-transparent, for interior wood.
   b. First Intermediate Coat: Polyurethane varnish matching topcoat.
   c. Second Intermediate Coat: Polyurethane varnish matching topcoat.
   d. Topcoat: Varnish, interior, polyurethane, oil-modified, satin (Gloss Level 4).

END OF SECTION 099300

SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and supplementary Conditions and Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of signs:

1. Interior ADA Room Signs.
2. Symbols of Accessibility.
3. Exterior Cast Letters and Numbers on Buildings.
4. Miscellaneous signage.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 1 "Temporary Facilities and Controls" for temporary project identification signs.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.

B. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.

C. Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, reinforcement, accessories, layout, and installation details.

1. Provide message list for each sign required, including large-scale details of wording and layout of lettering.

2. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
3. Furnish full-size spacing templates for individually mounted dimensional letters and numbers.

D. Samples: Provide the following samples of each sign component for initial selection of color, pattern and surface texture as required and for verification of compliance with requirements indicated.

1. Samples for initial selection of color, pattern, and texture:

a. Cast Acrylic Sheet and Plastic Laminate: Manufacturer's color charts consisting of actual sections of material including the full range of colors available for each material required.

1) Transparent Sheet: Where sheet material is indicated as "clear" provide colorless sheet in matte finish, with light transmittance of 92 percent, when tested in accordance with the requirements of ASTM D 1003.

b. Aluminum: Samples of each finish type and color, on 6-inch-long sections of extrusions and not less than 4-inch squares of sheet or plate, showing the full range of colors available.

2. Samples for verification of color, pattern, and texture selected, and compliance with requirements indicated:

a. Cast Acrylic Sheet and Plastic Laminate: Provide a sample of each type of sign. Include a sign for each color, texture, and pattern required. On each panel include a representative sample of the graphic image process required, showing graphic style, and colors and finishes of letters, numbers, and other graphic devices.

b. Aluminum: Samples of each finish type and color, on 6-inch-long sections of extrusions and not less than 4-inch squares of sheet or plate. Where finishes involve normal color and texture variations include sample sets showing the full range of variations expected.

c. Dimensional Letters: Provide one full-size representative sample of each dimensional letter type required, showing letter style, color, and material finish and method of attachment.

E. Certification: Provide written certification from the sign manufacturer that signage meets ADA requirements.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: For each separate type of sign required, obtain signs from one source from a single manufacturer.
B. Design Criteria: The drawings and specifications indicate size, profiles, and dimensional requirements of signs and are based on the specific type and model indicated. Signs by other manufacturers may be considered provided that deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.

C. Signage must comply with "Americans with Disabilities" (ADA) standards.

1.5 PROJECT CONDITIONS

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers" Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Andco Industries Corp.
2. A.C. Davenport & Son Co.
3. A.S.I. Sign Systems
4. Inter Sign National, Inc.
5. Spanjer Brothers, Inc.
6. The Supersine Company.
7. Southwell Company.
8. Leeds.

B. General Requirements

1. All letters shall be Helvetica Medium, upper case, unless otherwise noted.
2. Letters shall be centered on signs unless otherwise indicated.
3. Panel backgrounds shall be colored from manufacturer's standards with a matte finish.

2.2 MATERIALS

A. Photopolymer: Solid one-piece photopolymer sheet, in sizes and thicknesses indicated.

B. Aluminum Castings: Provide aluminum castings of alloy and temper recommended by the aluminum producer and finisher for the casting process used and for the use and finish indicated.

C. Fasteners: Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.

D. Anchors and Inserts: Use nonferrous metal or hot-dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel of lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

E. Applied Vinyl: Die-cut characters from vinyl film of nominal thickness of 3 mils (0.076 mm) with pressure-sensitive adhesive backing, suitable for exterior applications.

2.3 ROOM SIGNS

A. ROOM SIGN TYPE R1

1. Sign Size: Minimum 6″ x 6″.
2. Thickness: 1/8”
3. Type: 1/32″ raised letters.
4. Letter font: Myriad Pro
5. Letter Size: 1 1/4” high.
6. Insert window: Insert window to accommodate updatable text inserts, sized to accommodate two (2) lines of 5/8” text.
7. Locations: Provide new signage identifying each room listed on Finish Schedule at each door, excluding exterior and vestibule doors. Mount at 60” AFF on wall at latch side of door, in accordance with ADA guidelines. Field verify locations with the Architect and/or Owner before installation.
8. Provide type 2 braille plate with room name as part of all room signs.
9. Comply with all ADA requirements.
10. Wording on Sign: Text will approximate that which is shown on the finish schedule. Owner will review the shop drawing submittal and advise the Contractor of any revisions.
11. Provide rear blanks at all glass mounted locations.

B. ROOM SIGN TYPE R2

1. Sign Size: Minimum 6″ x 6″.
2. Thickness: 1/8”
3. Type: 1/32″ raised letters.
4. Letter font: Myriad Pro
5. Letter Size: 1 1/4” high.
6. In-Use indicator: Slide bar indicator for In-Use and Available.
7. Locations: Provide new signage identifying each room listed on Finish Schedule at each door, excluding exterior and vestibule doors. Mount at 60” AFF on wall at latch side of door, in accordance with ADA guidelines. Field verify locations with the Architect and/or Owner before installation.
8. Provide type 2 braille plate with room name as part of all room signs.
9. Comply with all ADA requirements.
10. Wording on Sign: Text will approximate that which is shown on the finish schedule. Owner will review the shop drawing submittal and advise the Contractor of any revisions.
11. Provide rear blanks at all glass mounted locations.

C. ROOM SIGN TYPE R3

1. Sign Size: Minimum 6″ x 6″.
2. Thickness: 1/8”
3. Type: 1/32″ raised letters.
4. Letter font: Myriad Pro
5. Letter Size: 1 1/4” high.
6. Locations: Provide new signage identifying each room listed on Finish Schedule at each door, excluding exterior and vestibule doors. Mount at 60” AFF on wall at latch side of door, in accordance with ADA guidelines. Field verify locations with the Architect and/or Owner before installation.
7. Provide type 2 braille plate with room name as part of all room signs.

8. Comply with all ADA requirements.
9. Wording on Sign: Text will approximate that which is shown on the finish schedule. Owner will review the shop drawing submittal and advise the Contractor of any revisions.
10. Provide rear blanks at all glass mounted locations.

D. ROOM SIGN TYPE R4

1. Sign Size: Minimum 6″ x 6″.
2. Thickness: 1/8”
3. Type: 1/32″ raised letters.
4. Letter font: Myriad Pro
5. Letter Size: 1 1/4” high.
6. Locations: Provide new signage identifying each room listed on Finish Schedule at each door, excluding exterior and vestibule doors. Mount at 60” AFF on wall at latch side of door, in accordance with ADA guidelines. Field verify locations with the Architect and/or Owner before installation.
7. Provide type 2 braille plate with room name as part of all room signs.
8. Symbol: International symbol for Male or Female, and handicapped insignia.
9. Comply with all ADA requirements.
10. Wording on Sign: Text will approximate that which is shown on the finish schedule. Owner will review the shop drawing submittal and advise the Contractor of any revisions.
11. Provide rear blanks at all glass mounted locations.

E. ROOM SIGN TYPE R5

1. Sign Size: Minimum 6″ x 6″.
2. Thickness: 1/8”
3. Type: 1/32″ raised letters.
4. Letter font: Myriad Pro
5. Letter Size: 1 1/4” high.
6. Locations: Provide new signage identifying each room listed on Finish Schedule at each door, excluding exterior and vestibule doors. Mount at 60” AFF on wall at latch side of door, in accordance with ADA guidelines. Field verify locations with the Architect and/or Owner before installation.
7. Provide type 2 braille plate with room name as part of all room signs.
8. Symbol: International symbol for Male and Female, and handicapped insignia.
9. Comply with all ADA requirements.
10. Wording on Sign: Text will approximate that which is shown on the finish schedule. Owner will review the shop drawing submittal and advise the Contractor of any revisions.
11. Provide rear blanks at all glass mounted locations.

F. ROOM SIGN TYPE R6

1. Applied vinyl lettering and logos as indicated on drawings.
2. Color: To be selected by the Architect, from manufacturer’s full range of colors.

2.9 INTERIOR AND EXTERIOR CAST LETTERS AND NUMBERS ON BUILDINGS

A. Type: Cast aluminum letters. Provide cast aluminum letters with clear anodized finish. Furnish cast units with smooth flat faces, sharp corners, true lines and accurate profiles. Provide units free of pits, scale, sand holes, or other defects. Protect exposed surfaces with two coats of clear, non-yellowing lacquer. Provide five-year finish guarantee.

B. Type: Cast aluminum logo. Provide cast aluminum logo with baked enamel finish. Furnish cast units with smooth flat faces, sharp corners, true lines and accurate profiles. Provide units free of pits, scale, sand holes, or other defects. Protect exposed surfaces with two coats of clear, non-yellowing lacquer. Provide five-year finish guarantee.

C. Type: Cast aluminum numbers. Provide cast aluminum number with clear anodized finish. Furnish cast units with smooth flat faces, sharp corners, true lines and accurate profiles. Provide units free of pits, scale, sand holes, or other defects. Protect exposed surfaces with two coats of clear, non-yellowing lacquer. Provide five-year finish guarantee.

D. CAST LETTER SIGN TYPES

1. CAST LETTER SIGN TYPE CL1

a. Sign Size: As indicated on the drawings.
b. Location: As indicated on the drawings.
c. Thickness: 1”
d. Letter font: Times New Roman MT
e. Letter Size: As indicated on the drawings.
f. Letter Finish: Baked Enamel, White
g. Logo Finish: Baked Enamel, White.
h. Mounting: Provide concealed anchors, tight to wall face, install in accordance with manufacturer’s recommendations.
i. Comply with Owner’s “Branding Standards”.

3. CAST LETTER SIGN TYPE CL3

a. Sign Size: As indicated on the drawings.
b. Location: As indicated on the drawings.
c. Thickness: 1”
d. Letter font: Times New Roman MT
e. Letter Size: As indicated on the drawings.
f. Letter Finish: Baked Enamel, White
g. Logo Finish: Baked Enamel, White.
h. Mounting: Provide concealed anchors, tight to wall face, install in accordance with manufacturer’s recommendations.
i. Comply with Owner’s “Branding Standards”.

4. CAST LETTER SIGN TYPE CL4

a. Sign Size: As indicated on the drawings.

b. Location: As indicated on the drawings.
c. Thickness: 1/2”
d. Logo Finish: Baked Enamel, color as selected by the Architect/Owner, from manufacturer’s full range of colors..
e. Mounting: Mounting: Provide concealed anchors, tight to wall face, install in accordance with manufacturer’s recommendations.
f. Comply with Owner’s “Branding Standards”.

5. CAST LETTER SIGN TYPE CL5

a. Sign Size: As indicated on the drawings.
b. Location: As indicated on the drawings.
c. Thickness: 1/2”
d. Logo Finish: Satin stainless steel,
e. Mounting: Provide concealed anchors which project letters ½″ from wall; install in accordance with manufacturer's recommendations.
f. Comply with Owner’s “Branding Standards”.

6. CAST LETTER SIGN TYPE CL6

a. Sign Size: As indicated on the drawings.
b. Location: As indicated on the drawings.
c. Thickness: 1”
d. Letter font: Myriad Pro
e. Letter Size: As indicated on the drawings.
f. Letter Finish: Baked Enamel, White
g. Mounting: Provide concealed anchors, tight to wall face, install in accordance with manufacturer’s recommendations.
h. Comply with Owner’s “Branding Standards”.

2.10 MISCELLANEOUS SIGNS

A. Provide as part of Base Bid Work of this section a $3,000.00 allowance for additional signage as directed by Owner/Architect.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.

3. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.

4. Attach signs with concealed theft-proof fasteners.

B. Installation of Room Signs:

1. Mount on wall or glass sidelight with top of sign four feet above floor on the latch side of single doors and on the right side when facing double doors from corridor side, unless specifically shown or approved otherwise.

3.2 CLEANING AND PROTECTION

A. At completion of the installation, clean soiled sign surfaces in accordance with the manufacturer's instructions. Repair or replace damaged signs as directed by the Architect. Protect units from damage until acceptance by Owner.

3.3 SIGN SCHEDULE

Room No.	Room Name	Room Title	User Name	Location Door No.	Sign Type
101	OFFICE	President	*TBD*	111-1	R1
102A	RECEPT/WAITING	Office of the President	*N/A*	102-1	R3 & R6
102B	GENERAL OFFICE	N/A	*N/A*		N/A
102C	WAITING	N/A	*N/A*		N/A
103	OFFICE	Administrative Assistant to the President	*TBD*	103-1	R1
104	OFFICE	Vice President	*TBD*	104-1	R1
105	OFFICE	Vacant	*TBD*	105-1	R1
106	LOBBY	Delaware Technical Community College LOGO	*N/A*		R3
107	RESTROOM	Toilet	*N/A*	107-1	R5
108	VESTIBULE	N/A	*N/A*		N/A
109	FILE/STORAGE	File Room	*N/A*		R3
110	VESTIBULE	N/A	*N/A*		N/A
111	CORRIDOR	N/A	*N/A*		N/A
112	SUPPORT OFFICES / CORRIDOR	Human Resources	*N/A*	112-1	R3
113	OFFICE	Office	*TBD*	113-1	R1
114	OFFICE	Office	*TBD*	114-1	R1
115	OFFICE	Office	*TBD*	115-1	R1
116	OFFICE	Office	*TBD*	116-1	R1
117	OFFICE	Vice President	*TBD*	117-1	R1
118	OFFICE	Office	*TBD*	118-1	R1
119	OFFICE/WORKROOM	Work Room	*N/A*	119-1 & 119-2	R1
120	FILE/STORAGE	File Room	*N/A*	120-1	R3
121	OFFICE	Office	*TBD*	121-1	R1

122	OFFICE	Office	*TBD*	122-1	R1
123	OFFICE	Office	*TBD*	123-1	R1
124	BOARD ROOM	Board Room	*N/A*	124-1	R2
124A	DATA	N/A	*N/A*		N/A
125	CLOSET	N/A	*N/A*		N/A
126	LOUNGE	Lounge	*N/A*	126-1	R3
127	OFFICE	Office	*N/A*	127-1	R1
128	WOMEN	Women	*N/A*	128-1	R4
129	MEN	Men	*N/A*	129-1	R4
130	OFFICE	Office	*TBD*	130-1	R1
131	SUPPORT OFFICES / CORRIDOR	Academic Affairs	*N/A*	131-1	R3
132	JANITOR CLOSET	Custodial	*N/A*	132-1	R3
133	OFFICE	Office	*TBD*	133-1	R1
Room No.	Room Name	Room Title	User Name	Location Door No.	Sign Type
134	OFFICE	Office	*TBD*	134-1	R1
135	OFFICE	Office	*TBD*	135-1	R1
136	OFFICE	Office	*TBD*	136-1	R1
137	OFFICE	Office	*TBD*	137-1	R1
138	OFFICE	Office	*TBD*	138-1	R1
139	FILE/STORAGE	File Room	*N/A*	139-1	R3
140	MECHANICAL ROOM	Mechanical Room	*N/A*	140-1	R3
141	OFFICE	Vice President of Finance	*TBD*	141-1	R1
142	FILE/STORAGE	File Room	*N/A*		R3
143	OFFICE	Office	*TBD*		R1
144	CORRIDOR	Finance	*N/A*	144-2	R3
145	CONFERENCE ROOM	Conference Room	*N/A*	145-1	R2
146	MDF ROOM	N/A	*N/A*		R3
147	SUPPLY ROOM	Supply	*N/A*	147-1	R3
148	IT OFFICE	Office	*TBD*	148-1	R1
149	MAIL/COPY/PRINT ROOM		*N/A*		R3
150	CONFERENCE ROOM	Conference Room	*N/A*	150-1	R2
151	SUPPORT OFFICES / CORRIDOR	Payroll & Finance	*N/A*	151-1	R3
152	OFFICE	Office	*TBD*	152-1	R1
153	OFFICE	Office	*TBD*	153-1	R1
154	OFFICE	Office	*TBD*	154-1	R1
155	OFFICE	Office	*TBD*	155-1	R1
156	OFFICE	Office	*TBD*	156-1	R1
157	SUPPORT OFFICES / CORRIDOR	Finance	*N/A*	157-1	R3
158	FILE ROOM	File Room	*N/A*	158-1	R3
159	OFFICE	Office	*TBD*	159-1	R1

160	OFFICE	Office	*TBD*	160-1	R1
161	OFFICE	Office	*TBD*	161-1	R1
162	OFFICE	Office	*TBD*	162-1	R1
163	OFFICE	Office	*TBD*	163-1	R1
Exterior	Main Entrance	Delaware Technical Community College Office of the President			
	Northwest Corner	Delaware Technical Community College Office of the President			
	North	Delaware Technical Community College Office of the President			
	Main Entrance	Address	*100*		

END OF SECTION 101400

SECTION 102113 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid-polymer toilet compartments configured toilet enclosures and urinal screens.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for supports that attach floor-and-ceiling-anchored compartments to overhead structural system.
2. Division 06 Section "Miscellaneous Rough Carpentry" for blocking floor-and-ceiling-anchored compartments.
3. Division 10 Section "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.4: For particleboard, documentation indicating that product contains no urea formaldehyde.
2. Laboratory Test Reports for Credit IEQ 4: For adhesives and composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.

1. Show locations of cutouts for compartment-mounted toilet accessories.
2. Show locations of reinforcements for compartment-mounted grab bars.

3. Show locations of centerlines of toilet fixtures.

D. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.

E. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each type of material, color, and finish required for units, prepared on 6-inch- (152-mm-) square Samples of same thickness and material indicated for Work.
2. Each type of hardware and accessory.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).

C. Brass Castings: ASTM B 584.

D. Brass Extrusions: ASTM B 455.

E. Steel Sheet: Commercial steel sheet for exposed applications; mill phosphatized and selected for smoothness.

1. Electrolytically Zinc Coated: ASTM A 879/A 879M, 01Z (03G).
2. Hot-Dip Galvanized: ASTM A 653/A 653M, either hot-dip galvanized or galvannealed.

F. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

G. Stainless-Steel Castings: ASTM A 743/A 743M.

H. Zamac: ASTM B 86, commercial zinc-alloy die castings.

I. Particleboard: ANSI A208.1, Grade M-2 with 45-lb (20.4-kg) density, made with binder containing no urea formaldehyde.

J. Plastic Laminate: NEMA LD 3, general-purpose HGS grade, 0.048-inch (1.2-mm) nominal thickness.

K. Adhesives: Manufacturer's standard product that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 SOLID-POLYMER UNITS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Accurate Partitions Corporation.
2. Ampco, Inc.
3. Bradley Corporation; Mills Partitions.
4. Comtec Industries/Capitol Partitions.
5. General Partitions Mfg. Corp.
6. Global Steel Products Corp.

7. Hadrian Manufacturing Inc.
8. Knickerbocker Partition Corporation.
9. Metpar Corp.
10. Partition Systems Incorporated of South Carolina.
11. Rockville Partitions Incorporated.
12. Santana Products, Inc.
13. Sanymetal; a Crane Plumbing company.
14. Weis-Robart Partitions, Inc.

A. Toilet-Enclosure Style: Overhead braced Floor anchored.

B. Urinal-Screen Style: Wall hung flat panel.

C. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) or polypropylene (PP) panel material, not less than 1 inch (25 mm) thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.

1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
2. Heat-Sink Strip: Manufacturer's standard continuous, stainless-steel strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
3. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer's full range.

D. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.

E. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets, stainless steel.
2. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

F. Overhead Cross Bracing for Ceiling-Hung Units: As recommended by manufacturer and fabricated from solid polymer.

2.3 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Material: Stainless steel.
2. Hinges: Manufacturer's standard paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.

5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.4 FABRICATION

A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

B. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

   a. Pilasters and Panels: 1/2 inch (13 mm).
   b. Panels and Walls: 1 inch (25 mm).

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than two brackets attached near top and bottom of panel.

   a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.

b. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches (51 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

D. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Warm-air dryers.
3. Underlavatory guards.
4. Custodial accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.

1. Approved full-size Samples will be returned and may be used in the Work.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify products using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.8 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.

E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.
5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
6. Tubular Specialties Manufacturing, Inc.

B. Toilet Tissue (Roll) Dispenser A:

1. Basis-of-Design Product: Bobrick B-2888.
2. Description: Double-roll dispenser.
3. Mounting: Surface mounted.
4. Material and Finish: Stainless steel, No. 4 finish (satin).

C. Combination Towel (Folded) Dispenser/Waste Receptacle J:

1. Basis-of-Design Product: Bobrick B3944.
2. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
3. Mounting: Semirecessed.

   a. Designed for nominal 4-inch (100-mm) wall depth.

4. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
5. Minimum Waste-Receptacle Capacity: 12 gal. (45.4 L).
6. Material and Finish: Stainless steel, No. 4 finish (satin).
7. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.

D. Liquid-Soap Dispenser E:

1. Basis-of-Design Product: Bobrick B-4063.

2. Description: Designed for dispensing soap in liquid or lotion form.
3. Mounting: Horizontally oriented, recessed.
4. Capacity: 50 oz. (1.5 L).
5. Materials: Stainless steel, No. 4 finish (satin).
6. Lockset: Tumbler type.
7. Refill Indicator: Window type.

E. Seat-Cover Dispenser K:

1. Basis-of-Design Product: Bobrick B-3013.
2. Mounting: Recessed.
3. Minimum Capacity: 500 seat covers.
4. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
5. Lockset: Tumbler type.

F. Grab Bar B:

1. Basis-of-Design Product: Bobrick B-6806.99 x 18.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.

    a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.

4. Outside Diameter: 1-1/2 inches (38 mm).
5. Configuration and Length: Straight, 16 inches (455 mm) long.

G. Grab Bar C:

1. Basis-of-Design Product: Bobrick B-6806.99 x 36.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.

    a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.

4. Outside Diameter: 1-1/2 inches (38 mm).
5. Configuration and Length: Straight, 36 inches (914 mm) long.

H. Grab Bar D:

1. Basis-of-Design Product: Bobrick B-6806.99 x 42.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.

    a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.

4. Outside Diameter: 1-1/2 inches (38 mm).
5. Configuration and Length: Straight, 42 inches (1065 mm) long.

I. Sanitary-Napkin Disposal Unit L:

1. Basis-of-Design Product: Bobrick B-270.
2. Mounting: Surface mounted.
3. Door or Cover: Self-closing, disposal-opening cover.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

J. Mirror Unit F:

1. Basis-of-Design Product: Bobrick B-165-1830.
2. Frame: Stainless-steel channel.

    a. Corners: Manufacturer's standard.

3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.

    a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
    b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

4. Size: 18” wide x 30” tall.

K. Mirror Unit G:

1. Basis-of-Design Product: Bobrick B-290-2560.
2. Frame: Stainless-steel channel.

    a. Corners: Manufacturer's standard.

3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.

    a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
    b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

4. Size: 24” wide x 60” tall.

2.3 WARM-AIR DRYERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Dryer, Inc.
3. American Specialties, Inc.

4. Bobrick Washroom Equipment, Inc.
5. Bradley Corporation.
6. Excel Dryer Corporation.
7. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
8. Tubular Specialties Manufacturing, Inc.
9. World Dryer Corporation.

B. Warm-Air Dryer N:

1. Basis-of-Design Product: Comac Corporation, Inc., “Blast”.
2. Mounting: Semi-recessed, with Comac stainless steel recess kit.
3. Operation: Electronic-sensor activated with timed power cut-off switch.

   a. Operation Time: 10 seconds.

4. Cover Material and Finish: Stainless steel, No. 4 finish (satin).
5. Electrical Requirements: 240 V, 6.3 A, 1450 W.

2.4 UNDERLAVATORY GUARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Plumberex Specialty Products, Inc.
2. Truebro by IPS Corporation.

B. Underlavatory Guard H1:

1. Basis-of-Design Product: Truebro Lavatory Shield 2800.
2. Description: Molded PVC covering for supply and drain piping assemblies that prevent direct contact with and burns from piping.
3. Material and Finish: Rigid high-impact, stain-resistant PVC, white.

C. Underlavatory Guard H2:

1. Basis-of-Design Product: Truebro Basin Guard #36.
2. Description: Molded PVC pipe cover panel for vanity lavatories, for supply and drain piping assemblies that prevent direct contact with and burns from piping.
3. Material and Finish: Rigid high-impact, stain-resistant PVC, white.

2.5 CUSTODIAL ACCESSORIES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.

3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.
5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
6. Tubular Specialties Manufacturing, Inc.

B. Mop and Broom Holder M:

1. Basis-of-Design Product: Bobrick B-239.
2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 36 inches (914 mm).
4. Hooks: Four.
5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, No. 4 finish (satin).

a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.
b. Rod: Approximately 1/4-inch- (6-mm-) diameter stainless steel.

2.6 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 104413 - FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire protection cabinets for the following:

a. Portable fire extinguishers.

B. Related Sections:

1. Division 09 painting Sections for field painting fire protection cabinets.
2. Division 10 Section "Signage" for directional signage to out-of-sight fire extinguishers and cabinets.
3. Division 10 Section "Fire Extinguishers."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.

1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
2. Show location of knockouts for hose valves.

B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: For each type of fire protection cabinet indicated.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Size: 6 by 6 inches (150 by 150 mm) square.

E. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to fire protection cabinets including, but not limited to, the following:

a. Schedules and coordination requirements.

1.6 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire hoses, hose valves, and hose racks indicated are accommodated.

C. Coordinate sizes and locations of fire protection cabinets with wall depths.

1.7 SEQUENCING

A. Apply vinyl lettering on field-painted, fire protection cabinets after painting is complete.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:

1. Sheet: ASTM B 209 (ASTM B 209M).
2. Extruded Shapes: ASTM B 221 (ASTM B 221M).

C. Stainless-Steel Sheet: ASTM A 666, Type 304.

D. Copper-Alloy Brass Sheet: ASTM B 36/B 36M, alloy UNS No. C26000 (cartridge brass, 70 percent copper).

E. Copper-Alloy Bronze Sheet: ASTM B 36/B 36M, alloy UNS No. C28000 (muntz metal, 60 percent copper).

F. Clear Float Glass: ASTM C 1036, Type I, Class 1, Quality q3, [**3**] [**6**] mm thick.

G. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

H. Break Glass: Clear annealed float glass, ASTM C 1036, Type I, Class 1, Quality q3, 1.5 mm thick, single strength.

I. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.

J. Wire Glass: ASTM C 1036, Type II, Class 1, Form 1, Quality q8, Mesh m1 (diamond), 6 mm thick.

K. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), [**1.5**] [**3**] [**6**] mm thick, with Finish 1 (smooth or polished).

L. Acrylic Bubble: One piece.

2.2 FIRE PROTECTION CABINET FEC-1

A. Cabinet Type: Suitable for fire extinguisher.

1. Products: Basis-of Design, Croker 1651, or equivalent.

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Steel sheet.

1. Shelf: Same metal and finish as cabinet.

D. Recessed Cabinet: Cabinet box semi-recessed in walls of sufficient depth to suit style of trim indicated.

1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

E. Cabinet Trim Material: Steel sheet.

F. Door Material: Steel sheet.

G. Door Style: Fully glazed panel with frame.

H. Door Glazing: Acrylic sheet.

1. Acrylic Bubble Color: Clear, transparent.

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide manufacturer's standard.
2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

J. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.

a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet glazing.
2) Application Process: Pressure-sensitive vinyl letters.
3) Lettering Color: Red.
4) Orientation: Vertical.

K. Finishes:

1. Manufacturer's standard baked-enamel paint for the following:

a. Exterior of cabinet door, and trim except for those surfaces indicated to receive another finish.
b. Interior of cabinet and door.

2. Steel: Baked enamel or powder coat.

2.3 FIRE PROTECTION CABINET FEC-2

A. Cabinet Type: Suitable for fire extinguisher and hose valve.

1. Products: Basis-of Design, Croker 1750, or equivalent.

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Steel sheet.

1. Shelf: Same metal and finish as cabinet.

D. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.

1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

E. Cabinet Trim Material: Steel sheet.

F. Door Material: Steel sheet.

G. Door Style: Fully glazed panel with frame.

H. Door Glazing: Acrylic sheet.

1. Acrylic Sheet Color: Clear transparent acrylic sheet.

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting door pull and friction latch.
2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

J. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.

a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet glazing.

2) Application Process: Pressure-sensitive vinyl letters.
3) Lettering Color: Red.
4) Orientation: Vertical.

K. Finishes:

1. Manufacturer's standard baked-enamel paint for the following:

a. Exterior of cabinet door and trim except for those surfaces indicated to receive another finish.
b. Interior of cabinet and door.

2. Steel: Baked enamel or powder coat.

2.4 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.
4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning.

B. Factory Prime Finish: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for hose and cabinets to verify actual locations of piping connections before cabinet installation.

B. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire protection cabinets in locations and at mounting heights indicated.

1. Fire Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes portable, hand-carried fire extinguishers.

B. Related Sections:

1. Division 10 Section "Fire Extinguisher Cabinets."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FMG.

C. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:

a. Schedules and coordination requirements.

1.7 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Amerex Corporation.
b. Ansul Incorporated; Tyco International Ltd.
c. Badger Fire Protection; a Kidde company.
d. Buckeye Fire Equipment Company.
e. Fire End & Croker Corporation.
f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
g. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
h. Larsen's Manufacturing Company.

i. Moon-American.
j. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc.
k. Potter Roemer LLC.
l. Pyro-Chem; Tyco Safety Products.

2. Valves: Manufacturer's standard.
3. Handles and Levers: Manufacturer's standard.
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

B. Multipurpose Dry-Chemical Type in Steel Container FE-1: UL-rated 4A-80-B:C, 10-lb (4.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.2 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Amerex Corporation.
b. Ansul Incorporated; Tyco International Ltd.
c. Badger Fire Protection; a Kidde company.
d. Buckeye Fire Equipment Company.
e. Fire End & Croker Corporation.
f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
g. Larsen's Manufacturing Company.
h. Potter Roemer LLC.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: [54 inches (1372 mm) above finished floor to top of fire extinguisher.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 105626 - MOBILE STORAGE SHELVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Manually operated systems.
2. Mechanically assisted systems.

B. Related Sections
1. Division 03 - Concrete Work
2. Division 09 - Finishes

1.3 COORDINATION

A. Recessed Tracks: Coordinate size and location of recesses in concrete with installation of recessed tracks.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, installation instructions and finishes for each type of mobile shelving systems and accessories.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.

C. Shop Drawings:

1. Provide plans, elevations, sections, and details which identify each unit corresponding to sequence of installation and erection procedures. Specifically include:
   a. Location, position and configuration of all tracks on or recessed in all floors.
   b. Plan layouts of positions of carriages, including all required clearances.
   c. Details of shelving, indicating method and configuration of installation in carriages
2. Show shelving layout.
3. Show location and extent of rail system including depth required if recessed.
4. Show clear-aisle widths from face of carriages.
5. Show dimension of clearances, spacing and relation to adjacent construction.
6. Show installation details at non-standard conditions
7. Provide installed weight, load criteria, furnished specialties, and accessories.
8. Detail fabrication and installation of mobile shelving systems including methods of anchoring shelves to carriages and rails to building structure as required for seismic restraint.
9. Wiring Diagrams: Power and control wiring if supplied.
10. Include methods of connection for motors and controls and location of electrical rough-in.

D. Samples: For each exposed product and for each color and texture specified, 3” square (76 mm) in size.

E. Samples for Initial Selection: For units with factory-applied finishes, 3” square (76 mm) in size.

F. Samples for Verification: For the following products, one of each, in manufacturer's standard size:

1. Flat shelving.
2. Each type of specialized shelving.
3. Front panels.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Design Calculations: For seismic design of mobile storage shelving systems including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

B. Qualification Data: For Installer.

C. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For mobile shelving systems to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Maintenance Data: Provide in form suitable for inclusion in maintenance manuals for mobile storage units. Data shall include operating and maintenance instructions, parts inventory listing, purchase source listing, emergency instructions, and related information.
   1. Submit manufacturer's instructions for proper maintenance materials and procedures.
   2. Submit manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use conditions. Include precautions against using materials and methods which may be detrimental to finishes and performance.

B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

   1. Shelf Units: Five (5) of each size and type indicated.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Engage an experienced manufacturer who is ISO 9001 certified for the design, production, installation and service of carriage mounted high-density mobile storage units and support rails. Furnish certificate attesting manufacturer’s ISO 9001 quality system registration

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of mobile shelving systems that fail in materials or workmanship within specified warranty period.

   1. Failures include, but are not limited to, the following:

      a. Deterioration of metals, metal finishes, and other materials beyond normal wear.

   2. Warranty Period: Warrant the entire movable compact shelving installation against defects in materials and workmanship for a period of five (5) years from date of Substantial Completion.

1.10 DELIVERY, STORAGE AND HANDLING

A. Follow manufacturer’s instructions and recommendations for delivery, storage and handling requirements.

1.11 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions before fabrication. Indicate verified measurements on Shop Drawings. Coordinate fabrication and delivery to ensure no delay in progress of the Work.

B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating mobile storage units. Coordinate construction to ensure actual dimensions correspond to established dimensions.

1.12 SEQUENCING AND SCHEDULING

A. Sequencing: Coordinate storage shelving system installation with other work to minimize possibility of damage and soiling during remainder of construction period.

B. Scheduling: Plan installation to commence after finishing operations, including painting have been completed.

C. Built-In Items: Provide components which must be built in at a time which causes no delays general progress of the Work.

D. Pre-installation Conference: Schedule and conduct conference on project site to review methods and procedures for installing mobile storage units including, but not limited to, the following:

E. Review project conditions and levelness of flooring and other preparatory work performed under other contracts.

F. Review and verify structural loading limitations.

G. Recommended attendees include:
   1. Owner's Representative.
   2. Prime Contractor or representative.
   3. The Architect.
   4. Manufacturer's representative.
   5. Subcontractors or installers whose work may affect, or be affected by, the work of this section.

1.13 SYSTEM DESCRIPTION

A. General: The system consists of [manufactured][owner furnished] storage units mounted on manufacturer’s track-guided carriages to form a compact storage system. System design permits access to any single aisle by manually moving units until the desired aisle is opened. The carriage/rail system provides uniform carriage movement along the total length of travel, even with unbalanced loads.

B. Carriage System Design and Features: The carriage system consists of a formed structural steel frame with machined and balanced wheels riding on steel rails [recessed][surface] mounted to the floor. Rails shall be types selected by the manufacturer to ensure smooth operation and self-centering of mobile storage units during travel without end play or binding. Rail types, quantities and spacing shall be selected by the manufacturer to suit installation conditions and requirements. All bearings used in the drive mechanism shall be permanently shielded and lubricated.

C. Movement Controls: Triple or single arm operating wheels with rotating hand knobs shall be provided on the accessible (drive) ends of shelf units, centered on the end panel, located 40 inches (1051MM) from the base of each unit to permit units to be moved to create a single aisle opening. Turning the handle transmits power through chain drive to drive wheels on each carriage.

D. Drive System: The system shall be designed with a positive type mechanically-assisted drive which minimizes end play, ensures there is no play in the drive handle, and that carriages will stop without drifting.
   1. System shall include a chain sprocket drive system for each movable carriage to ensure that carriages move uniformly along the total length of travel, even with unbalanced loads. All system components shall be selected to ensure a smooth, even movement along the entire carriage length. Drive system gearing shall be designed to permit 1 lb. of force applied to the drive handle to move a minimum of 4,000 lbs. of load.
   2. A tensioning device shall be provided on each chain drive with provision for adjusting tension without removing end panels.
   3. All bearings used in the drive mechanism shall be permanently shielded and lubricated.

E. Safety Features:
   1. Color-coded visual indicators shall provide verification that carriages are in a locked or unlocked mode.
   2. A single safety lock button, mounted on each operating wheel hub, will permit moving a carriage in either direction to create a new access aisle when pulled out (unlocked), or locking the carriage when pushed in.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Spacesaver Corporation or comparable product.

B. Source Limitations: Obtain mobile storage systems including shelving from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Mobile shelving systems shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Structural Performance: Provide mobile shelving systems capable of supporting the following:
   1. Total Load: 3200lbs (1455kg) per wheel.

C. Operating Force: For manually operated systems, maximum 1 lbf (4.45 N) required to move 4000 lbs (1812 kg).

2.3 MECHANICALLY OPERATED SYSTEMS AND COMPONENTS

A. General: Provide manufacturer's standard mobile storage shelving systems and components. Where components are not otherwise indicated, provide manufacturer's standard components as required for a complete system.

B. Recycled Content of Steel: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Rails:
   1. Material: ASTM/AISI Type 1035 or 1045 steel, manufacturer’s selection.
   2. Mounting: Recessed
   3. Capacity: 1,000 pounds per lineal foot (1385kg/M) of carriage.
   4. Minimum Contact Surface: 5/8 inch (16MM) wide.
   5. Provide rail sections in minimum 6 foot (1.83M) lengths.
   6. Rail configuration shall permit attachment to top of structural floor system with provision for leveling rails to compensate for variations in floor surface level.
   7. Provide rail connections designed to provide horizontal and vertical continuity between rail sections, to gradually transfer the concentrated wheel point load to and from adjoining rail sections. Butt joints are not permitted.

D. Floor / Ramp:
   1. Floor/Ramp Sheathing: Minimum 3/4 inch (19MM), 5-ply underlayment grade plywood. Particle board sheathing materials are not permitted.
   2. Provide fire retardant treated floor/ramp materials when required by code.
   3. Finished flooring materials shall be provided by others as specified in Division 09.

E. Carriages:
   1. Provide manufacturer's design movable carriages fabricated of welded or bolted steel construction. Galvanized structural components and/or riveted carriages are unacceptable.
   2. Provide fixed carriages of same construction and height as the movable carriages, anchored to rails. Setting fixed shelving directly on floors is not permitted.
   3. When required, provide bolted carriage splices designed to maintain proper unit alignment and weight load distribution.

4. Design carriages to allow the shelving uprights to recess and interlock into the carriages a minimum of 3/4 inch (19MM). Top mount carriages are unacceptable.
5. Provide each carriage with minimum two wheels per rail.
6. Bumpers: Provide two rubber bumpers with minimum depth of 1/2 inch (13 mm) each side.
7.

F. Drive / Guide System:
1. Design: Provide drive system which prevents carriage whipping, binding and excessive wheel/rail wear under normal operation.
2. If line shafts are used, all wheels on one side of carriage shall drive.
3. If synchronized drives are used, a minimum of one wheel assembly driving both sides of carriage at center location required. Drive shaft shall exhibit no play or looseness over the entire length of that assembly.
4. Shafts: Solid steel rod or tube.
5. Shaft Connections: Secured couplings.
6. Bearing Surfaces: Provide rotating load bearing members with ball or roller bearings. Provide shafts with pillow block or flanged self-aligning type bearings.

G. Wheels:
1. Capacity: Minimum load capacity per wheel: 3200 lbs (1455kg).
2. Size: Minimum 5 inches (127MM), outside diameter drive wheels.
3. Guides: Determined by manufacturer; minimum 2 locations.

H. Accessories:
1. Mechanical Sweep and Safety Stop (Non-Powered)

I. Inserts: Furnish required concrete inserts and similar anchorage devices for installing track system, and furnish other components of work where installation of devices is specified in another Section.

J. Anti-Tip Brackets: Mount on carriage for engagement with track system to secure units against tipping.

K. Carriage End Panels: Full depth and height of shelving units. Provide at both ends of each range.

1. Material: To be selected by architect from manufacturer's standard line.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, minimum recess depth, and other conditions affecting performance of mobile shelving systems.

B. Verify that building structural system is adequate for installing mobile storage units at locations indicated on approved shop drawings.
   1. In new construction, ensure that recesses for rails in floors are at proper spacing and depths, with allowance for grouting.
   2. For installations on existing floors, ensure that rail spacings indicated on shop drawings are in proper locations so existing load-bearing structural members are not over stressed.

C. Verify that intended installation locations of mobile storage units will not interfere with nor block established required exit paths or similar means of egress once units are installed.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to proper performance of mobile storage units, once installed.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Level and plumb tracks to a tolerance of 0.09 inch in 120 inches (2.4 mm in 3048 mm) with no more than 0.06-inch (1.5-mm) variation between adjacent rails. Use non-shrink grout as indicated by manufacturer.

B. Recessed Track Systems: Solidly fill gaps between slab and rail according to manufacturer's written instructions to secure tracks and prevent movement.

C. Installation Tolerances: Do not exceed levelness of installed rails listed below:
   1. Maximum Variation From True Level Within Any Module: 3/32 inch (2.4MM).
   2. Maximum Variation Between Adjacent (Parallel) Rails: 1/16 inch (1.6MM), perpendicular to rail direction.
   3. Maximum Variation In Height: 1/32 inch (.8MM), measured along any 10 foot (3.05M) rail length.

D. Carriage Installation: Mount mobile carriages on track system with anti-tip brackets engaged by rails and adjust for smooth operation. Provide non-moving carriages securely fixed to rails where indicated.

3.3 SHELVING INSTALLATION

A. Attach shelving units to carriages according to manufacturer's written instructions and as required to prevent vibration during movement.

1. Level and plumb shelving units to a tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm).

B. Starter/Adder Units: Connect groups together with standard fasteners according to manufacturer's written instructions, using concealed fasteners where possible.

C. Install shelves in shelving units at locations indicated on Drawings and according to manufacturer's written instructions.

D. Shelving Enclosure Panels: Install end panels and canopy tops with concealed fasteners.

3.4 FIELD QUALITY CONTROL

A. Verify shelving unit alignment and plumb after installation. Correct if required following manufacturer’s instructions.

B. Remove components which are chipped, scratched, or otherwise damaged and which do not match adjoining work. Replace with new matching units, installed as specified and in manner to eliminate evidence of replacement.

C. Adjust components and accessories to provide smoothly operating, visually acceptable installation.

3.5 CLEANING AND PROTECTING

A. Immediately upon completion of installation, clear components and surfaces. Remove surplus materials, rubbish and debris resulting from installation upon completion of work and leave areas of installation in neat, clean condition.

B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

C. Protect installed products from damage during remainder of the construction period.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain mobile storage shelving.

END OF SECTION 105626

SECTION 113100 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cooking appliances.
2. Kitchen exhaust ventilation.
3. Refrigeration appliances.

B. Related Sections:

1. Division 22 Section "Plumbing Fixtures" for kitchen sinks, waste disposers, and instant hot-water dispensers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, dimensions, furnished accessories, and finishes for each appliance.

B. LEED Submittals:

1. Product Data for Credit EA 1.4: For appliances indicated, documentation that products are ENERGY STAR rated.
2. Product Data for Credit EA 9.2: For water-efficient clothes washer, documentation indicating modified energy factor and water factor.

C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.

D. Product Schedule: For appliances. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified manufacturer.

B. Product Certificates: For each type of appliance, from manufacturer.

C. Field quality-control reports.

D. Warranties: Sample of special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintains, within 500 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

B. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.

C. Source Limitations: Obtain residential appliances from single source and each type of residential appliance from single manufacturer.

D. Regulatory Requirements: Comply with the following:

1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. ANSI: Provide gas-burning appliances that comply with ANSI Z21 Series standards.

E. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

F. Preinstallation Conference: Conduct conference at Project site.

1.7 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.

B. Electric Range: Full warranty including parts and laborfor on-site service on surface-burner elements.

1. Warranty Period: Two years from date of Substantial Completion.

C. Microwave Oven: Full warranty including parts and labor for on-site service.

1. Warranty Period: Two years from date of Substantial Completion.

D. Refrigerator/Freezer, Sealed System: Full warranty including parts and labor for on-site service on the product.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 RANGES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amana; a division of Whirlpool Corporation.
2. BOSCH Home Appliances.
3. BSH Home Appliances Corporation (Thermador).
4. Dacor, Inc.
5. Dynamic Cooking Systems, Inc.; a subsidiary of Fisher & Paykel Appliances Holdings Limited.
6. Electrolux Home Products (Frigidaire).
7. Fisher & Paykel.
8. General Electric Company (GE).
9. General Electric Company (Hotpoint).
10. Jade Home Products Company.
11. Jenn-Air; a division of Whirlpool Corporation.
12. KitchenAid; a division of Whirlpool Corporation.
13. LG Appliances.
14. Maytag; a division of Whirlpool Corporation.
15. Samsung.
16. Sears Brands LLC (Kenmore).
17. Sharp Electronics Corp.
18. Viking Range Corporation.
19. Whirlpool Corporation.
20. Wolf Appliance, Inc.

B. Electric Range: Electric Range: Basis-of-Design GE JB680DTWW, or comparable product.

2.2 MICROWAVE OVENS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amana; a division of Whirlpool Corporation.
2. BOSCH Home Appliances.

3. BSH Home Appliances Corporation (Gaggenau).
4. BSH Home Appliances Corporation (Thermador).
5. Dacor, Inc.
6. Dynamic Cooking Systems, Inc.; a subsidiary of Fisher & Paykel Appliances Holdings Limited.
7. Electrolux Home Products (Frigidaire).
8. General Electric Company (GE).
9. General Electric Company (Hotpoint).
10. Jenn-Air; a division of Whirlpool Corporation.
11. KitchenAid; a division of Whirlpool Corporation.
12. LG Appliances.
13. Maytag; a division of Whirlpool Corporation.
14. Samsung.
15. Sears Brands LLC (Kenmore).
16. Sharp Electronics Corp.
17. Viking Range Corporation.
18. Whirlpool Corporation.
19. Wolf Appliance, Inc.

B. Microwave Oven: Basis-of-Design GE PSA2200RWW, or comparable product.

2.3 REFRIGERATOR/FREEZERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amana; a division of Whirlpool Corporation.
2. BOSCH Home Appliances.
3. BSH Home Appliances Corporation (Gaggenau).
4. BSH Home Appliances Corporation (Thermador).
5. Dacor, Inc.
6. Electrolux Home Products (Frigidaire).
7. Fisher & Paykel.
8. General Electric Company (GE).
9. General Electric Company (Hotpoint).
10. Jenn-Air; a division of Whirlpool Corporation.
11. KitchenAid; a division of Whirlpool Corporation.
12. LG Appliances.
13. Maytag; a division of Whirlpool Corporation.
14. Samsung.
15. Sears Brands LLC (Kenmore).
16. Sub-Zero, Inc.
17. Viking Range Corporation.
18. Whirlpool Corporation.

B. Refrigerator/Freezer: Basis-of-Design GE GTH16BBXRWW, with ice maker IM4A, or comparable product.

2.4 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

D. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions.

E. Utilities: See Divisions 22 and 26 for plumbing and electrical requirements.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After installation, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

C. An appliance will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION 113100

SECTION 122116 - VERTICAL LOUVER BLINDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vertical louver blinds with fabric vanes.

B. Related Requirements:

1. Division 06 Section "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting vertical louver blinds and accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details for vertical louver blinds.

C. Samples: For each exposed product and for each color and texture specified, 12 inches (300 mm) long.

D. Samples for Initial Selection: For each type of vertical louver blind.

1. Include similar Samples of accessories involving color selection.

E. Samples for Verification: For each type of vertical louver blind.

1. Vane: Not less than 12 inches (300 mm) long.

a. Fabric: 3-1/2 inches (90 mm) wide from dye lot used for the Work. Mark top and face of material.

2. Vertical Louver Blind: Full-size unit, not less than 36 inches (900 mm) wide by 36 inches (900 mm) long.
3. Valance: Full-size unit, not less than 12 inches (300 mm) wide.

F. Window-Treatment Schedule: For vertical louver blinds. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of vertical louver blind.

B. Product Test Reports: For each type of vertical louver blind, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For vertical louver blinds to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Vertical Louver Blinds: Full-size units equal to 5 percent of quantity installed for each size, color, texture, pattern, and finish indicated, but no fewer than two units.
2. Vanes: Furnish quantity of full-size units equal to 5 percent of quantity installed for each type, size, texture, pattern, and finish indicated, but no fewer than two units.

1.7 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver vertical louver blinds in factory packages, marked with manufacturer and product name, and location of installation using same designations indicated on Drawings.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install vertical louver blinds until construction and wet and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where vertical louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain vertical louver blinds from single source from single manufacturer.

2.2 VERTICAL LOUVER BLINDS, FABRIC VANES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hunter Douglas Contract.
2. Levolor Contract; a Newell Rubbermaid company.
3. Silent Gliss USA, Inc.
4. Solar Shading Systems.
5. Springs Window Fashions.

B. Vanes: PVC-coated polyester mesh free-hanging fabric with hemmed, nonraveling edges; stain and fade resistant; with not less than 3/8-inch (9.5-mm) overlap when vanes are rotated fully closed.

1. Width: 3-1/2 inches (89 mm).
2. Flame-Resistance Rating: Comply with NFPA 701; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
3. Features:

a. Weight, sewn in at bottom of vanes.
b. Bottom chain.

C. Headrail: Channel, formed steel or extruded aluminum with long edges returned or rolled and ends capped. Headrail encloses operating mechanisms including carrier-spacing mechanism that provides uniform vane spacing when blinds are traversed fully across headrail (closed).

1. Manual Traverse Control: Nickel-plated metal bead chain.
2. Manual Rotation Control: Nickel-plated metal bead chain.
3. Manual Control Locations: To be determined for each location.
4. Draw and Stack: Varies depending on locations.
5. Stack Release: Permitting stacked vanes to be moved away from stacking position for access to glazed opening.
6. Cord-Tensioner Mounting: Sill.

D. Carriers: Engineered plastic with gears to align and synchronize vane rotation and stems that allow vane removal and replacement. Lead carriers have self-lubricating wheels or elongated bearing surfaces; following carriers have self-lubricating wheels.

E. Valance: Manufacturer's standard with vane insert.

F. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.

1. Type: Overhead.
2. Intermediate Support: Provide intermediate support brackets to produce support spacing recommended by blind manufacturer for weight and size of blind.

G. Colors, Textures, and Patterns:

1. Vanes: As selected by Architect from manufacturer's full range.
2. Components: Provide materials exposed to view matching or coordinating with vanes unless otherwise indicated.

2.3 VERTICAL LOUVER BLIND FABRICATION

A. Product Safety Standard: Fabricate vertical louver blinds to comply with WCMA A 100.1 including requirements for corded, flexible, looped devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to cover window and other openings as follows, measured at 74 deg F (23 deg C):

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which blind is installed less 1/4 inch (6 mm) per side or 1/2 inch (13 mm) total, plus or minus 1/8 inch (3.1 mm). Length equal to head-to-sill or -floor dimension of opening in which blind is installed less 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm).

C. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.

1. Rotation-and-Traverse Mechanisms: With permanently lubricated moving parts.

D. Installation Brackets: Designed for easy removal and reinstallation of blind, for supporting headrail, valance, and operating hardware and for bracket positions and blind mounting method indicated.

E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to brackets and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.

F. Color-Coated Finish: For metal components exposed to view unless anodized or plated finish is indicated. Apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install vertical louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units according to manufacturer's written instructions.

1. Locate so exterior vane edges are not closer than 2 inches (51 mm) from interior faces of glass and not closer than 1 inches from interior faces of glazing frames through full operating ranges of blinds.
2. Install mounting and intermediate brackets to prevent deflection of headrails.
3. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating hardware of glazed openings, other window treatments, and similar building components and furnishings.

3.3 ADJUSTING

A. Adjust vertical louver blinds to operate free of binding or malfunction through full operating ranges.

3.4 CLEANING AND PROTECTION

A. Clean vertical louver blind surfaces after installation according to manufacturer's written instructions.

B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer and that ensures that vertical louver blinds are without damage or deterioration at time of Substantial Completion.

C. Replace damaged vertical louver blinds that cannot be repaired in a manner approved by Architect before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems.

3.6 LOCATIONS

A. Provide blinds at all exterior windows and/or storefront, except for rooms: 101 President’s Office, 110 Vestibule 124 Board Room and 150 Conference Room.

END OF SECTION 122116

SECTION 122200 - CURTAINS AND DRAPES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes draperies and drapery tracks.

B. Related Requirements:

1. Division 05 Section "Decorative Formed Metal" for drapery pockets.
2. Division 26 Sections for electrical connections to motorized tracks.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Tracks: Include maximum weights of draperies that can be supported.

2. Fabrics.

B. Shop Drawings:

1. Tracks: Show installation and anchorage details and locations of controls.

2. Draperies: Show sizes, locations, and details of installation.

C. Samples: For each drapery fabric and for each color and texture specified, 10 by 8 inches (250 by 200 mm) in size.

D. Samples for Verification: As follows:

1. Tracks: 18 inches (450 mm) long, with carriers, controls, and accessories.
2. Textile Trims: For each color and pattern indicated, 18 inches (450 mm) long.
3. Drapery Fabrication Samples: For each heading, fabric, color, and pattern indicated, a complete full-size panel to verify details of fabrication and thread colors.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For track installation; reflected ceiling plans drawn to scale and coordinating track installation with openings and ceiling-mounted items. Show the following:

1. Suspended ceiling components.

2. Track Pockets

1.5 CLOSEOUT SUBMITTAL

A. Maintenance Data: For products to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Track Carriers: For each size indicated, equal to five (5) percent of amount installed, but no fewer than 10 of each size.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: For draperies and tracks, fabricator of draperies.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup at location and in size shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify dimensions by field measurements before drapery fabrication, and indicate measurements on Shop Drawings.

B. Scheduling: Do not deliver or install draperies until after other finish work, including painting, is complete and spaces are otherwise ready for occupancy.

PART 2 - PRODUCTS

2.1 DRAPERY TRACKS

A. Manually Operated Track

1. Manufacturers: Subject to compliance with requirements, provide Kirsch Architrac or comparable product.

2. Corded Window Covering Product Standard: Provide drapery tracks operated by pull cords complying with WCMA A 100.1.

3. Construction: Extruded aluminum, slotted for mounting at interval of not more than 24 inches (610 mm) o.c.

   a. Lengths and Configurations: Full window width and overlaps.
   b. Support Capability: Weight of drapery indicated mounted on track length indicated.
   c. Finish: Clear anodic coating.

4. Mounting Brackets: Aluminum, of type suitable for fastening track to surface indicated and designed to support weight of track assembly and drapery plus force applied to operate track.

   a. Mounting Surface: Drapery pocket for rooms 101 President’s Office and 124 Board room; Wall mount for Conference 150.
   b. Size: Adjustable.

5. Installation Fasteners: Sized to support track assembly and drapery, and fabricated from metal compatible with track, brackets, and supporting construction. Provide two fasteners to fasten each bracket to supporting construction.
6. Operation: Cord tension pulley.

   a. Pulley Mounting Location: Wall.
   b. Draw: Two way, center opening.
   c. Operating Hardware Location: Right.

7. Carriers: Rollers with hooks.

   a. Master Carriers: Overlap.

8. End Stops: Manufacturer's standard.
9. Pulleys: Heavy duty.

2.2 DRAPERIES

A. Fire-Test-Response Characteristics: For fabrics treated with fire retardants, provide products that pass NFPA 701 as determined by testing of fabrics that were treated using treatment-application method intended for use for this Project by a testing and inspecting agency acceptable to authorities having jurisdiction.

B. Manufacturers: Subject to compliance with requirements, provide products by Michaels Textiles or comparable product.

C. Source Limitations: Obtain each color and pattern of drapery fabric and trim from one dye lot.

D. Drapery:

1. Heading:

   a. Pinch (French) Pleats 250 percent fullness; three-fold (fingers) each pleat.
   b. Pleat Spacing: 4”.
   c. Heading Accessories:

      1) Nonwoven buckram.

2. Drapery Fabric:

   a. Manufacturer: Michaels Textiles.
   b. Pattern: Rooster
   c. Color: Ivory
   d. Fiber Content: 100% Polyester.
   e. Orientation: Run right (up the bolt).
   f. Width: 58”
   g. Pattern Repeat Distance: 17” vertically; 14 ¾” horizontally.
   h. Textile Treatments: Stain repellent.

3. Lining Fabric:

   a. Lining Type: Blackout.
   b. Manufacturer: Selected by fabricator for use with drapery fabric indicated.
   c. Textile Treatments: Flame retardant, polymer type.

4. Hem Weights: 1-inch- (25-mm-) square lead weights.

2.3 DRAPERY FABRICATION

A. Fabricate draperies in heading styles and fullnesses indicated. Fabricate headings to stand erect. If less than a full width of fabric is required to produce panel of specified fullness, use equal widths of not less than one-half width of fabric located at ends of panel.

1. Center-Opening Draperies: Add 10 inches (254 mm) to overall width for overlap.

B. Seams: Sew vertical seams with twin-needle sewing machine with selvage trimmed and overlocked. Join widths so that patterns match and vertical seams lay flat and straight without puckering. Horizontal seams are not acceptable.

C. Side Hems: Double-turned, 1-1/2-inch- (38-mm-) wide hems consisting of three layers of fabric, and blindstitched so that stitches are not visible on face of drapery.

D. Bottom Hems: Double-turned, 4-inch- (102-mm-) wide hems consisting of three layers of fabric, and weighted and blindstitched so that weights and stitches are not visible on face of drapery.

1. Sew in square lead weights at each seam and at panel corners.

E. Linings: Equal to widths of drapery fabric and joined to drapery fabric at top by inside invisible seam, and hand stitched at side hems and shadowed with 1-1/2-inch (38-mm) return of face fabric.

1. Bottom Hem: Blind stitch to drapery fabric.

PART 3 - EXECUTION

3.1 LOCATIONS

A. Drapery tracks and draperies shall be installed according to these specifications on all windows in the following rooms: 101 President’s Office, 124 Board Room, 150 Conference Room.

3.2 DRAPERY TRACK INSTALLATION

A. Install track systems according to manufacturer's written instructions, level and plumb, and at height and location in relation to adjoining openings as indicated on Drawings.

B. Isolate metal parts of tracks and brackets from concrete, masonry, and mortar to prevent galvanic action. Use tape or another method recommended in writing by track manufacturer.

3.3 DRAPERY INSTALLATION

A. Where draperies abut overhead construction, hang draperies so that clearance between headings and overhead construction is 1/4 inch (6.4 mm).

B. Where draperies extend to floor, install so that bottom hems clear finished floor by not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm).

3.4 ADJUSTING

A. After hanging draperies, test and adjust each track to produce unencumbered, smooth operation.

B. Steam and dress down draperies as required to produce crease- and wrinkle-free installation.

C. Remove and replace draperies that are stained or soiled.

END OF SECTION 122200

SECTION 123200 - MANUFACTURED WOOD CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced wood cabinets of stock design.
2. Solid-surfacing-material countertops.

B. Related Sections:

1. Division 06 Section "Miscellaneous Rough Carpentry" for wood blocking for anchoring manufactured wood casework.
2. Division 09 Section "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring manufactured wood casework.
3. Division 09 Section "Resilient Base and Accessories" for resilient base applied to manufactured wood casework.

1.3 DEFINITIONS

A. MDF: Medium-density fiberboard.

B. Exposed Portions of Cabinets: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches (1220 mm) above floor, and surfaces visible in open cabinets.

C. Semiexposed Portions of Cabinets: Surfaces behind opaque doors, such as interiors of cabinets, shelves, dividers, interiors and sides of drawers, and interior faces of doors. Tops of cases 78 inches (1980 mm) or more above floor are defined as semiexposed.

D. Concealed Portions of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, and ends and backs that are placed directly against walls or other cabinets.

E. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive, and faced both front and back with hardwood veneers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Certificates for Credit MR 6: Chain-of-custody certificates indicating that wood used to produce cabinets and countertops complies with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
3. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that product contains no urea formaldehyde.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show fabrication details, including types and locations of hardware. Show installation details, including field joints and filler panels. Indicate manufacturer's catalog numbers for casework.

D. Samples for Initial Selection: For cabinet finishes and for each type of top material indicated.

E. Samples for Verification: 8-by-10-inch (200-by-250-mm) Samples for each type of finish, including top material and the following:

1. Section of countertop showing top, front edge, and backsplash construction.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Warranty: Sample of special warranty.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish complete touchup kit for each type and finish of manufactured wood casework provided. Include scratch fillers, stains, finishes, and other materials necessary to perform permanent repairs to damaged casework finish.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

C. Source Limitations: Obtain manufactured wood casework from single source from single manufacturer.

D. Quality Standard: Unless otherwise indicated, comply with requirements for modular cabinets in AWI's "Architectural Woodwork Quality Standards."

1. Provide AWI Quality Certification Program certificate indicating that manufactured wood casework complies with requirements.

E. Quality Standard: Unless otherwise indicated, comply with WI's "Manual of Millwork" for Custom grade.

1. Provide WI-certified compliance certificate indicating that manufactured wood casework complies with requirements of grades specified.
2. Product Designations: Drawings indicate manufactured wood casework configurations by referencing WI design series numbering system as defined in WI's "Manual of Millwork."

F. Product Designations: Drawings indicate sizes, configurations, and finish material of manufactured wood casework by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish material, and complying with the Specifications may be considered. Refer to Division 01 Section "Product Requirements."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver manufactured wood casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.

B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install manufactured wood casework until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install manufactured wood casework until building is enclosed, wet work is complete, and HVAC system is operating and maintaining

temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 43 and 70 percent during the remainder of the construction period.

C. Field Measurements: Verify actual dimensions of construction contiguous with manufactured wood casework by field measurements before fabrication.

1.10 COORDINATION

A. Coordinate layout and installation of framing and reinforcements in walls and partitions for support of manufactured wood casework.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of manufactured wood casework that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Delamination of components or other failures of glue bond.
b. Warping of components.
c. Failure of operating hardware.
d. Deterioration of finishes.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Plastic-Laminate-Faced Manufactured Casework:

a. Architectural Cabinet Systems; a division of Windham Millwork, Inc.
b. Cal-Dak Cabinets.
c. CampbellRhea; a Sagas International company.
d. Case Systems Inc.
e. CIF Furniture Ltd.
f. Diversified Fixture.
g. Fisher Hamilton L.L.C.
h. Goelst USA, LLC.
i. Hausmann Industries, Inc.

j. International Office Products Cooperative.
k. LSI Corporation of America; a Sagas International company.
l. Mid Canada Millwork Ltd.
m. R. C. Smith Company.
n. Sidney Millwork Company.
o. Stevens Industries, Inc.
p. Techline USA, LLC.
q. Terrill Manufacturing Company.
r. TMI Systems Design Corporation.
s. UCMI.

2.2 MATERIALS, GENERAL

A. Certified Wood: Fabricate cabinets and countertops from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

B. Low-Emitting Materials: Fabricate manufactured wood casework, including countertops, with adhesives and composite wood products containing no urea formaldehyde.

C. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.

D. Hardwood Plywood: HPVA HP-1, either veneer core or particleboard core unless otherwise indicated.

E. Softwood Plywood: DOC PS 1.

F. Particleboard: ANSI A208.1, Grade M-2.

G. Particleboard: Straw-based particleboard complying with ANSI A208.1, Grade M-2, except for density.

H. MDF: ANSI A208.2, Grade 130.

I. Hardboard: AHA A135.4, Class 1 Tempered.

J. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.

1. Basis of design product: Subject to compliance with requirements, provide Wilsonart International or comparable product:

a. Abet Inc.
b. Arborite; a division of ITW Canada.
c. Formica Corporation.
d. Lamin-Art, Inc.
e. Nevamar Company, LLC; Decorative Products Div.
f. Panolam Industries International Incorporated.

K. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

L. Edgebanding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3 mm thick at doors and drawer fronts, 1 mm thick elsewhere.

M. Edgebanding for Thermoset Decorative Panels: PVC or polyester edge banding complying with LMA EDG-1 and matching thermoset decorative panels.

N. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, suitable for exposed applications.

O. Stainless-Steel Sheet: ASTM A 240 or ASTM A 666, Type 304, with No. 4 satin finish.

P. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.

1. Basis of design product: Subject to compliance with requirements, provide DuPont Corian or comparable product:

   a. ABA Industries.
   b. Avonite Surfaces; Aristech Acrylics LLC.
   c. Formica Corporation.
   d. LG Solid Source, L.L.C.
   e. Meganite Inc.; a division of The Pyrochem Group.
   f. Nevamar Company, LLC; Decorative Products Div.
   g. Samsung; Cheil Industries Inc.
   h. Swan Corporation (The).
   i. Transolid, Inc.
   j. Wilsonart International; Div. of Premark International, Inc.

2. Type: Provide Standard type unless Special Purpose type is indicated.
3. Integral Sink Bowls: Comply with ISSFA-2 and ANSI Z124.3, Type 5 or Type 6, without a precoated finish.

2.3 CABINET MATERIALS

A. Exposed Cabinet Materials:

1. Plastic Laminate: Grade HGS.
2. Unless otherwise indicated, provide specified edgebanding on all exposed edges.

B. Semiexposed Cabinet Materials:

1. Thermoset Decorative Panels: Provide thermoset decorative panels for semiexposed surfaces unless otherwise indicated.
2. Metal for Steel Drawer Pans: Cold-rolled, steel sheet.
3. Unless otherwise indicated, provide specified edgebanding on all semiexposed edges.

C. Concealed Cabinet Materials:

1. Plastic Laminate: Grade BKL.

2.4 DESIGN, COLOR, AND FINISH

A. Thermoset Decorative Panel Colors, Patterns, and Finishes: As selected by Architect from thermoset decorative panel manufacturer's full range of solid colors.

B. Plastic Laminate Colors Patterns and Finishes: Wild Cherry #7054.

C. PVC Edgebanding Color: As selected from casework manufacturer's full range

D. Solid-surfacing Material Colors and Patterns: Savannah.

2.5 CABINET FABRICATION

A. Plastic-Laminate-Faced Cabinet Construction: As required by referenced quality standard, but not less than the following:

1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch (19-mm) particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semiexposed surfaces.
2. Shelves: 3/4-inch (19-mm) thermoset decorative panels.
3. Backs of Cabinets: 1/2-inch (12.7-mm) particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semiexposed surfaces.
4. Drawer Fronts: 3/4-inch (19-mm) particleboard, plastic-laminate faced.
5. Drawer Sides and Backs: 1/2-inch (12.7-mm) thermoset decorative panels, with glued dovetail or multiple-dowel joints.
6. Drawer Bottoms: 1/4-inch (6.4-mm) thermoset decorative panels glued and dadoed into front, back, and sides of drawers. Use 1/2-inch (12.7-mm) material for drawers more than 24 inches (600 mm) wide.
7. Doors: 3/4-inch (19-mm) particleboard or MDF, plastic-laminate faced.

B. Leg Shoes: Vinyl or rubber, black, open-bottom type.

C. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.

2.6 CASEWORK HARDWARE AND ACCESSORIES

A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware.

1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.

B. Frameless Concealed Hinges (European Type): BHMA A156.9, Type B01602, 135 degrees of opening, self-closing.

C. Pulls: Solid stainless-steel wire pulls, fastened from back with two screws. Provide 2 pulls for drawers more than 24 inches (600 mm) wide.

D. Drawer Slides: BHMA A156.9, Type B05091.

1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated, steel ball-bearing slides.
2. Box Drawer Slides: Grade 1, for drawers not more than 6 inches (150 mm) high and 24 inches (600 mm) wide.
3. File Drawer Slides: Grade 1HD-100, for drawers more than 6 inches (150 mm) high or 24 inches (600 mm) wide.

E. Drawer and Hinged Door Locks: Cylindrical (cam) type, 5-pin tumbler, brass with chrome-plated finish, and complying with BHMA A156.11, Grade 1.

1. Provide a minimum of two keys per lock and six master keys.
2. Provide locks on all doors and drawers.

F. Adjustable Shelf Supports: 2-pin locking plastic shelf rests complying with BHMA A156.9, Type B04013.

G. Grommets for Cable Passage through Countertops: 2-inch (51-mm) OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.

2.7 COUNTERTOPS

A. Countertops, General: Provide smooth, clean exposed tops and edges in uniform plane free of defects. Provide front and end overhang of 1 inch (25 mm) over base cabinets.

B. Solid-Surfacing-Material Tops: 1/2-inch- (12.7-mm-) thick, solid-surfacing material with front edge built up with same material.

1. Front: Straight, slightly eased at top.
2. Backsplashes: 3/4-inch- (19-mm-) thick, solid-surfacing material; slightly eased at edge.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of manufactured wood casework.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CASEWORK INSTALLATION

A. Install level, plumb, and true; shim as required, using concealed shims. Where manufactured wood casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

B. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch (1.5 mm) of a single plane. Fasten cabinets to masonry or framing, wood blocking, or reinforcements in walls and partitions with fasteners spaced 24 inches (600 mm) o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch (1.5 mm).

1. Where base cabinets are not installed adjacent to walls, fasten to floor at toe space with fasteners spaced 16 inches (400 mm) o.c. Secure sides of cabinets to floor, where they do not adjoin other cabinets, with not less than two fasteners.

C. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch (1.5 mm) of a single plane. Fasten to hanging strips, masonry, or framing, blocking, or reinforcements in walls or partitions. Align similar adjoining doors to a tolerance of 1/16 inch (1.5 mm).

1. Fasten through back, near top and bottom, at ends, and not more than 16 inches (400 mm) o.c.
2. Use No. 10 wafer-head screws sized for 1-inch (25-mm) penetration into wood framing or blocking at wood-framed partitions.
3. Use No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish at metal-framed partitions.

D. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.

E. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 INSTALLATION OF TOPS

A. Field Jointing: Where possible make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches (150 mm) of front and back edges and at intervals not exceeding 24 inches (600 mm). Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

B. Secure tops to cabinets with Z- or L-type fasteners or equivalent, using two or more fasteners at each front, end, and back.

C. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.

D. Secure backsplashes and end splashes to walls with adhesive.

E. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.4 CLEANING AND PROTECTING

A. Repair or remove and replace defective work as directed on completion of installation.

B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

C. Protection: Provide 6-mil (0.15-mm) plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches (1220 mm) o.c. Remove protection at Substantial Completion.

END OF SECTION 123200

SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Entrance mats.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for slab depression grouting and filling for recessed mats and frames.

1.3 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. LEED Submittals:

1. For Super Nop 52 Tile indoor installations: submit documentation substantiating that Release-Bond adhesive is Green Label Plus certified and therefore contributes to Indoor Environmental Quality Credit 4.1.
2. Submit documentation substantiating that the project has permanently installed Super Nop 52 Tile that is at least ten feet in length and therefore contributes to Indoor Environmental Quality Credit 5.

C. Samples for Initial Selection: For each type of product indicated.

D. Samples for Verification: For each type of product indicated.

1. Floor Mat: 12-inch- (300-mm-) square, assembled sections of floor mat.
2. Tread Rail: 12-inch- (300-mm-) long Sample of each type and color.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For floor mats and frames to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Entrance Tiles: Full-size units equal to 2 percent of amount installed for each size, color, and pattern indicated, but no fewer than 10 units.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain floor mats through one source from a single manufacturer.

B. Accessibility Requirements: Provide installed floor mats that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." Sections 302 and 303 in ICC A117.1.

1.7 PROJECT CONDITIONS

A. Field Measurements: Indicate measurements on Shop Drawings.

1.8 COORDINATION

A. Coordinate size and location of recesses in concrete with installation of finish floors to receive floor mats and frames.

PART 2 - PRODUCTS

2.1 ENTRANCE TILES

A. Basis-of-Design Product: Subject to compliance with requirements, provide Mats, Inc., Super Nop 52 Tile or a comparable product by one of the following:

1. American Floor Products Company, Inc.
2. Cactus Mat Mfg. Co.
3. Consolidated Plastics Company, Inc.
4. Durable Corporation.
5. Flexco.
6. Matco International.
7. Turtle Plastics.

B. Carpet-Type Tiles: Polypropylene carpet bonded to 1/8- to 1/4-inch- (3- to 6-mm-) thick, flexible vinyl backing to form mats 3/8 or 7/16 inch (9.5 or 11 mm) thick with nonraveling edges.

1. Colors, Textures, and Patterns: As selected by Architect from manufacturer's full range.
2. Tile Size: 20 inch x 20 inch.

2.2 FABRICATION

A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and floor conditions for compliance with requirements for location, sizes, and other conditions affecting installation of floor mats and frames.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PROTECTION

A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION 124813

SECTION 130660 - BULLET RESISTANT ALUMINUM DOOR & FRAME ASSEMBLY

PART 1 GENERAL

1.1 REFERENCE

A. Underwriters Laboratory UL 752-Standard for Bullet Resisting Equipment, ASTM C 1172 - Standard Specification for Laminated Architectural Flat Glass, NIJ Standard 0108.01 - (National Institute of Justice) Standard for Ballistic Resistant Protective Materials (September, 1985). ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate, ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.2 SUBMITTALS

A. The following shall be submitted by the manufacturer in accordance with any Special Contract Requirements: Submit for approval prior to fabrication: samples, product data (including preparation, storage and installation methods), cuts & anchor spacing, reinforcement & location , product specifications, shop drawings, test reports (current UL Listing Verification & UL 752 Test Results as provided by Underwriters Laboratories), and printed data in sufficient detail to indicate compliance with the contract documents.

B. Provide manufacturer's instructions for installation and cleaning of Bullet Resistant Aluminum Door Assemblies. All required submittals shall be approved prior to installation.

1.3 DESIGN PERFORMANCE

A. Through the design, manufacturing techniques and material application the Bullet Resistant Aluminum Door shall be constructed of an extruded aluminum in 6061-T6 alloy/tempered. With a UL Standard 752 Level 2 protection rating. Door and frame to have no exposed fasteners, corner joints shall consist of extruded and keyed aluminum spline with continuous 3/8" diameter steel tie rod at door top and bottom rails. All joints and connections shall be tight, providing hairline points and true alignment of adjacent members. Panels shall not be removable from threat side. Door system to be available in Right hand, left hand and reverse swings.

B. Door to defeat ballistic assaults from a .44 magnum superpower small arms handgun as tested with UL Standard 752 at Underwriters Laboratories.

1.4 QUALITY ASSURANCE

A. Manufacturer shall be a Company that specializes in manufacturing products of the specified type with a minimum of five years experience. Installer shall be a Company that specializes in product type specified. Manufacturer shall provide a sample with color/finish to the Architect for approval prior to start of work.

1.5 DELIVERY, STORAGE & HANDLING

A. Delivery the materials to the project with the manufacturer's UL Listed Labels intact and legible. Handle the materials with care to prevent damage. Store materials inside and under cover, stack flat and off floor. Project conditions (temperature, humidity, and ventilation) shall be within the maximum limit recommendations set by manufacturer. Do not install products that are under conditions outside these limits.

1.6 WARRANTY

A. All materials shall be warranted against defects for a period of 1 year for the date of receipt at the project site. Certificates of manufacturer's standard limited warranty shall be provided at project completion.

PART 2 PRODUCTS

2.1ACCEPTABLE MANUFACTURERS

A. Products shall be manufactured by: Total Security Solutions, Inc, 170 National Park Drive, Fowlerville, MI 48836, or comparable product.

2.2 PRODUCT: BULLET RESISTANT STOREFRONT FRAMING LEVEL 2

A. Bullet Resistant Door System: Total Security Solutions Bullet Resistant Aluminum TSS-BL2-DR Bullet Resistant Door System. All joints and connections shall be tight, providing hairline joints and true alignment of adjacent members. Corner joinery shall consist of heavy duty extruded and keyed aluminum corner splines with continuous 3/8 inch diameter tie rod construction. Glazing must not be removable from the threat side of the door. Provide to dimension heights and widths indicated on the Drawings.

1. System shall be designed to defeat ballistic assaults from a .44 magnum handgun in accordance with UL 752, Level 2.
   a. Aluminum Doors: Top rail and stile 5", Bottom rail 10" including glass stops.
   b. Aluminum Door and Sidelight Frames and Extrusions: 1 ¾" (44mm) x 4" (102mm), Structural section .125" thickness
   c. Glazing: LP-1250 Polycarbonate/Acrylic Laminate, 1-1/4" thick, 7.7lbs/sf. UL 752, UL=3, 44 mag.

2.Door Frame Construction: Frames shall provide equal UL protection level as door, non-ricochet type, Aluminum ballistic extruded aluminum in 6061-T6 alloy, aluminum finish. Door hardware includes: HD continuous hinge, push/pull handle, mortised lock, overhead closer. Optional hardware: exit devices, electric strike plate, and custom security hardware. Shipped fabricated and ready for field installation.

1) Style: 5" wide style door system

B.Finish: Anodized Aluminum, Dark Bronze Anodized Aluminum, match existing

PART 3 EXECUTION

3.1 PREPARATION

A. Prior to installing the bullet resistive material, the contractor shall verify that all supports have been installed as required by the contract documents and architectural drawings, and approved shop drawings, if required. Installer shall notify architect of any unsatisfactory preparation that is responsibility of another installer.

B. Clean and prepare all surfaces per manufacturers recommendations for achieving the best results for the substrate under the project conditions.

3.2 INSTALLATION

A. Do not begin installation until openings have been verified and surfaces properly prepared in accordance with Drawings. Install in accordance with manufacturer’s instructions and UL 752. Set all equipment plumb.

B. TSS Bullet Resistant Aluminum Door shall be installed in accordance with manufacturer's instructions. Install plumb, level, square, true to line, and without warp or rack. Provide all fasteners required for installation. Anchor frames securely in place to supports. Use attachment methods permitting adjustment for construction tolerances, irregularities, alignment, and expansion and contraction. Separate aluminum from other metal surfaces with bituminous coatings or other means approved by Architect.

3.3 POST APPLICATION

A. TSS Bullet Resistant Aluminum Door shall be installed in accordance with manufacturer’s printed recommendations, including adhering to anchoring and finishing details. Method of application shall maintain the bullet resistive rating at junctures with concrete floor slabs, the concrete roof slabs, the bullet resistive door frames, the bullet resistive window frames and all required penetrations.

B. Inspection and Cleaning: Verify installation is complete and complies with manufacturer’s requirements. Clean product and accessories, removing excess sealant, labels and protective covers.

C. Touch-up, repair or replace damaged products before Substantial Completion.

D. Product Warranty: Applicable warranty shall be issued to owner upon final release of completed project.

END OF SECTION 130660

SECTION 130661 - BULLET VOICE AROUND WINDOW

PART 1 GENERAL

1.1 REFERENCE

A. Underwriters Laboratory UL 752-Standard for Bullet Resisting Equipment & ASTM E119-98- Standard Test Methods for Fire Tests of Building Construction and Materials, NIJ Standard 0108.01-(National Institute of Justice) Standard for Ballistic Resistant Protective Materials, ASTM B 209/B 209M- Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate, ASTM A 666-Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar..

1.2 SUBMITTALS

A. The following shall be submitted by the manufacturer in accordance with any Special Contract Requirements: Submit for approval prior to fabrication: samples, product data (including preparation, storage and installation methods), cuts & anchor spacing, reinforcement & location , product specifications, shop drawings, test reports (current UL Listing Verification & UL 752 Test Results as provided by Underwriters Laboratories), and printed data in sufficient detail to indicate compliance with the contract documents.
B. Manufacturer’s Instructions for installation and cleaning of Bullet Transaction Window Assemblies. All required submittals shall be approved prior to installation.

1.3 DESIGN PERFORMANCE

A. Through the design, manufacturing techniques and material application the Aluminum Voice Around Transaction Window shall be of the “non-ricochet” type. This design is intended to permit the encapture and retention of an attacking projectile lessening the potential of a random injury or lateral penetration. This assembly shall provide single transaction positions utilizing the “natural voice rail” configuration. This design shall employ mounting blocks in vertical framing tubes to complete the “natural voice rail” design. Each transaction position shall have a stainless steel dip tray as shown on the drawings. Components must be manufactured in strict accordance with the specifications, design and details. All vision panels shall be cut to size with all exposed edges polished. Necessary holes shall be pre drilled and tapped where required. Stainless Steel assembly screws and acrylic spacers shall be provided. Anodized angles and channels shall be provided. Anchor screws shall be provided by the installer.
B. No field alterations to the construction of the units fabricated under the acceptable standards shall be allowed unless approved by the manufacturer and the architect. Standard manufacturing tolerances shall be +/- 1/16".
C. Materials shall meet or exceed UL 752 requirements.

1.4 QUALITY ASSURANCE

A. Manufacturer shall be a Company that specializes in manufacturing products of the specified type with a minimum of five years experience. Installer shall be a Company that specializes in product type specified and Certified for the installation by the manufacturer. Manufacturer shall provide a Mock-up, if required, for evaluation of surface preparation and application workmanship and color/finish to the Architect for approval prior to start of work.

1.5 DELIVERY, STORAGE & HANDLING

A. Delivery the materials to the project with the manufacturer's UL Listed Labels intact and legible. Handle the materials with care to prevent damage. Store materials inside and under cover, stack flat and off floor. Project conditions (temperature, humidity, and ventilation) shall be within the maximum limit recommendations set by manufacturer. Do not install products that are under conditions outside these limits.

1.6 WARRANTY

A. All materials shall be warranted against defects for a period of 1 year for the date of receipt at the project site. Certificates of manufacturer's standard limited warranty shall be provided at project completion.

PART 2 PRODUCTS

2.1ACCEPTABLE MANUFACTURERS

A. Products shall be manufactured by: Total Security Solutions, Inc, 170 National Park Drive, Fowlerville, MI 48836, or comparable product.

2.2 BULLET RESISTANT ALUMINUM VOICE AROUND TRANSACTION WINDOW

A. Product shall be: TSS AVA Aluminum Voice Around Transaction Window:. All aluminum transaction window allows for natural voice communication without a breach of security. Available in a clear or bronze aluminum finish, incorporates either a plastic laminate or stainless steel counter..

B. Glazing Panels shall be:.

Bullet-Resisting Glazing Material Options:

Bullet Resistant Level 2
1" LP 1000 Laminated

C. Aluminum sections to be manufactured in accordance with ASTM B209, Extruded aluminum alloy 6063 T5 Anodized and be free of sharp edges or burrs when in place. Glazing Channel: U-Channel specifically designed for securing transparencies tightly in place. Angles and stops are only acceptable for top attachment.

1) Frame to be anodized aluminum. The bottom of the glazing to be capped with corresponding material on the frame (ie: stainless steel on stainless steel). Provide a shelf 2" thick with a recessed deal tray. The shelf to be full width of window, 12" deep, centered under the glazing and covered with a black high pressure laminate.(optional stainless steel 18 ga. #4 finish).

2). Deal tray to be 18 ga. stainless steel, # 4 finish 16" x 10" from the outside edge of flanges with a clear opening .

D.. Product size shall be: TSS AVA Aluminum Voice Around Transaction Window

1) Size shall be as shown on drawing

2) Color options shall be Dark Bronze, to match existing.

PART 3 EXECUTION

3.1 PREPARATION

A. Prior to installing the bullet resistive material, the contractor shall verify that all supports have been installed as required by the contract documents, architectural drawings, and approved shop drawings, if required. Installer shall notify architect of any unsatisfactory preparation that is responsibility of another installer.

B. Clean and prepare all surfaces per manufacturers recommendations for achieving the best results for the substrate under the project conditions.

3.2 INSTALLATION

A. Do not begin installation until openings have been verified and surfaces properly prepared in accordance with Drawings. Install in accordance with manufacturer's instructions and UL 752. Set all equipment plumb. All products shall be installed per installation instructions provided by Total Security Solutions, if warranty is to be issued.

B. TSS AVA Aluminum Voice Around Transaction Window: shall arrive on site as a completed unit. Unit shall be installed in provided opening (wall/door), secured to structure (anchors by others).

3.3 POST APPLICATION

A. TSS AVA Aluminum Voice Around Transaction Window shall be installed in accordance with manufacturer's printed recommendations, including adhering to anchoring and finishing details.

B. Inspection and Cleaning: Verify installation is complete and complies with manufacturer's requirements. Clean product and accessories, removing excess sealant, labels and protective covers.

C. Touch-up, repair or replace damaged products before Substantial Completion.

D. Product Warranty: Applicable warranty shall be issued to owner upon final release of completed project.

END OF SECTION 130661

SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Firestopping.
4. Grout.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sleeves and sleeve seals. Include rated capacities, and furnished specialties and accessories.

1. Galvanized-steel sheet pipe sleeves.
2. Flanged galvanized-steel pipe sleeves.
3. Sleeve-seal systems.
4. Firestopping.
5. Grout.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Galvanized-Steel Sheet: 0.0359-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Flanged Galvanized-Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, welded steel pipe with plain ends and a 2-inch minimum wide anchor flange welded to perimeter of sleeve. Set flange on perimeter of sleeve to obtain minimum of 2 inches concrete embedment.

2.2 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 FIRE STOPPING

A. Comply with requirements for firestopping specified in "Penetration Firestopping."

B. Provide premium products specified for each application as appropriate. Submit Product Data for all proposed firestopping materials with schedule of applications for review and approval.

2.4 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Beginning installation constitutes Contractor's acceptance of substrates and conditions.

3.2 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

C. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in "Joint Sealants."

D. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls, slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration,

assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Concrete Walls (above and below grade) and Floors:

   a. Piping Smaller than NPS 6: Flanged galvanized-steel pipe sleeves with sleeve-seal fittings.

      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

   b. Piping NPS 6 and Larger: Flanged galvanized-steel sheet sleeves with sleeve-seal fittings.

      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

2. Interior Metal Stud Partitions: Galvanized-steel sheet sleeves with joint sealant.

   a. In lieu of joint sealant, provide penetration firestopping at the following locations:

      1) Penetrations in fire-resistance-rated walls.
      2) Penetrations in smoke barriers.

3.5 GROUTING

A. Mix and install grout for plumbing sleeves and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout around sleeves and anchors.

F. Cure placed grout.

END OF SECTION 21 05 17

SECTION 21 05 18 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for escutcheons.

1. One-piece, cast-brass type escutcheon.
2. One-piece, stamped-steel type escutcheon.
3. Split-casting brass type escutcheon.
4. Split-plate, stamped-steel type escutcheon.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

C. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

D. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Beginning installation constitutes Contractor's acceptance of substrates and conditions.

3.2 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
2. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
4. Bare or Insulated Piping in Unfinished Service Spaces and Equipment Rooms: No escutcheons required.

3.3 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons using new materials.

END OF SECTION 21 05 18

SECTION 21 05 53 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment and piping labels.

1.3 ACTION SUBMITTALS

A. Product Data: For the following products:

1. Equipment labels.
2. Warning signs and labels
3. Pipe labels.
4. Valve tags.

1.4 CLOSEOUT SUBMITTALS

A. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.

B. Valve Schedules: Valve numbering scheme.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.

2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

C. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
B. Letter Color: White.
C. Background Color: Red.
D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
G. Fasteners: Stainless-steel rivets or self-tapping screws.
H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Not accepted.

D. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; pipe size; and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

E. Pipe-Label Colors:

1. Background Color: Red.
2. Letter Color: White.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032 inch thick, with predrilled holes for attachment hardware.
2. Fasteners: Brass beaded chain or S-hook.
3. Valve-Tag Color: Red.
4. Letter Color: White.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 LABEL INSTALLATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install or permanently fasten labels on each major item of mechanical equipment.

D. Locate equipment labels where accessible and visible.

E. Piping Color-Coding: Painting of piping is specified in "Interior Painting."

F. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.3 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems. List tagged valves in a valve-tag schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:

a. Wet-Pipe Sprinkler System: 1-1/2 inches, round.

3.4 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 21 05 53

SECTION 211100 - FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes fire-suppression water-service piping and related components outside the building and service entrance piping through floor into the building.

B. Related Sections:

1. Section 211313 "Wet-Pipe Sprinkler Systems" for wet-pipe fire-suppression sprinkler systems inside the building.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, and specialty locations, and elevations.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of site water mains.
2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Comply with the "Approval Guide," published by FM Global, or UL's "Fire Protection Equipment Directory" for fire-service-main products.

D. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

1.7 COORDINATION

A. Coordinate connection to water main with Architectural and General Contractor.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end.

C. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

1. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Push-on-Joint, Ductile-Iron Fittings: AWWA C153, ductile-iron compact pattern.

1. Gaskets: AWWA C111, rubber.

E. Flanges: ASME B16.1, Class 125, cast iron.

F. Ductile-Iron Deflection Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. EBAA Iron Inc.

2. Description: Compound, ductile-iron coupling fitting with sleeve and one or two flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
3. Pressure Rating: 250 psig minimum.

2.2 JOINING MATERIALS

A. Gaskets for Ferrous Piping: ASME B16.21, asbestos free.

2.3 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cascade Waterworks Manufacturing.
b. Dresser, Inc.; Dresser Piping Specialties.
c. Ford Meter Box Company, Inc. (The); Pipe Products Division.
d. JCM Industries.
e. Smith-Blair, Inc.; a Sensus company.
f. Viking Johnson.

2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners, and with ends of same sizes as piping to be joined.
3. Standard: AWWA C219.
4. Center-Sleeve Material: Manufacturer's standard.
5. Gasket Material: Natural or synthetic rubber.
6. Pressure Rating: 150 psig minimum.
7. Metal Component Finish: Corrosion-resistant coating or material.

2.4 GATE VALVES

A. UL-Listed or FM-Approved Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Cast Iron Pipe Company; American Flow Control Division.
   b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   c. Kennedy Valve; a division of McWane, Inc.
   d. M&H Valve Company; a division of McWane, Inc.
   e. Mueller Co.; Water Products Division.
   f. U.S. Pipe.

2. 175-psig, UL-Listed or FM-Approved, Iron, OS&Y, Gate Valves:

   a. Description: Iron body and bonnet and bronze seating material.
   b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
   c. Pressure Rating: 175 psig minimum.
   d. End Connections: Flanged or grooved.

2.5 BACKFLOW PREVENTERS

A. Refer to “Section 21 13 13, Wet-Pipe Sprinkler Systems” and Section 21 13 16, Dry-Pipe Sprinkler Systems” for descriptions of Backflow Preventers.

2.6 FIRE-DEPARTMENT CONNECTIONS

A. Refer to “Section 21 13 13, Wet-Pipe Sprinkler Systems” and “Section 21 13 16, Dry-Pipe Sprinkler Systems” for descriptions of Fire Department Connections”.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with excavating, trenching, and backfilling requirements in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Water-Main Connection: Connect to extended water main according to requirements of Architect and General Contractor for size and in location indicated.

B. Comply with NFPA 24 for fire-service-main piping materials and installation.

C. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

D. Bury piping with depth of cover over top at least 36 inches, with top at least 12 inches below level of maximum frost penetration, and according to the following:
   1. In Loose Gravelly Soil: With at least 12 inches of additional cover.

E. Extend fire-suppression water-service piping and connect to water-supply source and building fire-suppression water-service piping systems at locations and pipe sizes indicated.

   1. Terminate fire-suppression water-service piping above building floor slab. Terminate piping with flanges as required for piping material and in accordance with testing requirements of the City of Dover. Make connections to building's fire-suppression water-service piping systems when those systems are installed.

F. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

G. Comply with requirements in Section 211313 "Wet-Pipe Sprinkler Systems" for fire-suppression-water piping inside the building.

H. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

I. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.

B. Install flanges, flange adaptors, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

C. Ream ends of tubes and remove burrs.

D. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.

E. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.

G. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

H. Do not use flanges or unions for underground piping.

3.4 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.
2. Locking mechanical joints.
3. Set-screw mechanical retainer glands.
4. Bolted flanged joints.
5. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, valves, in fire-suppression water-service piping according to NFPA 24 and the following:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

D. Refer to anchorage requirements of the City of Dover.

3.5 VALVE INSTALLATION

A. UL-Listed or FM-Approved Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

B. UL-Listed or FM-Approved Valves Other Than Gate Valves: Comply with NFPA 24.

3.6 CONNECTIONS

A. Connect fire-suppression water-service piping to extended site fire service water main.

B. Connect fire-suppression water-service piping to interior fire-suppression piping.

3.7 FIELD QUALITY CONTROL

A. Use test procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described below.

B. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

C. Hydrostatic Tests: Test at not less than one-and-one-half times the working pressure for two hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psig. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

D. Prepare test and inspection reports.

3.8 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground fire-suppression water-service piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in "Earth Moving."

3.9 CLEANING

A. Clean and disinfect fire-suppression water-service piping as follows:

1. Purge new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for three hours.
c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

3.10 PIPING SCHEDULE

A. Underground fire-suppression water-service piping NPS 6 shall be the following:

1. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile- or gray-iron, standard-pattern or ductile-iron, compact-pattern fittings; glands, gaskets, and bolts; and gasketed joints.
2. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron compact-pattern fittings; and gasketed joints.

3.11 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

B. Indicator-post underground fire-suppression water-service valves NPS 3 and larger shall be 175-psig, UL-listed or FM-approved, iron, nonrising-stem gate valves with indicator-post flange.

END OF SECTION 211100

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinklers.
5. Alarm devices.
6. Pressure gages.

B. Related Sections:

1. Section 283111 “Digital, Addressable Fire-Alarm System” for alarm devices not specified in this Section.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.4 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

B. Glycol filled sprinkler system to be installed to serve the existing building Attic space and Main Entry Vestibule areas.

1.5 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Flow test information: Obtain flow test information from local water authority for use in final design. Pay all costs associated with conducting flow test.

   a. City of Dover, Department of Public Works
   b. Dover, Delaware, 19903
   c. Jason A Lyon
   d. (302) 736-7025

2. Available fire-hydrant flow test records indicate the following conditions:

   a. Date: 2004.
   b. Performed by: City of Dover.
   c. Location of Residual Fire Hydrant R: W. Dennys Rd.
   d. Location of Flow Fire Hydrant F: Delaware Tech Dr. and W. Demmys Rd.
   e. Static Pressure at Residual Fire Hydrant R: 50 psig.
   f. Measured Flow at Flow Fire Hydrant F: 1605 gpm.
   g. Residual Pressure at Residual Fire Hydrant R: 42 psig .

C. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 psig, including losses through water-service piping, valves, and backflow preventer.

2. Sprinkler Occupancy Hazard Classifications:
   a. Light Hazard Occupancy:
      1) All of the existing building and new addition, unless noted otherwise.

   b. Ordinary Hazard, Group 1 Occupancy:
      1) Mechanical Room.

3. Minimum Density for Automatic-Sprinkler Piping Design:
   a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
   b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.

4. Maximum Protection Area per Sprinkler:
   a. Office Spaces: 225 sq. ft..
   b. Mechanical Equipment Rooms: 130 sq. ft.
   c. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:

   a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
   b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

2. Sprinkler Head and Piping Layout:

a. Include field survey work required for obtaining dimensions and layout of existing obstructions and conditions affecting design and installation of fire protection systems.
b. Coordinate location of sprinkler heads and piping to eliminate interference with other work.
c. Sprinkler head layout drawings intended to represent general geometric appearance required for acceptable sprinkler installation within finished ceiling spaces. Do not interpret as representing maximum number of sprinklers required for compliance with NFPA 13 standards for building spaces to be sprinklered. Provide additional fire sprinklers coverage required for compliance with NFPA 13 standards and local fire department codes and ordinances using specified sprinkler heads.

3. Design sprinkler piping layout and piping supports in finished spaces to be hidden from view above ceilings, behind walls or inside chases. Coordinate with the Architect by highlighting areas on shop drawings where piping or supports cannot be concealed from view in finished spaces. Do not install exposed piping or piping supports in finished spaces without written approval of Architect. Piping and/or supports installed exposed to view without prior approval from Architect will be relocated at the Contractor’s expense.

4. Design sprinkler piping layout and sprinkler head layout in unfinished spaces including: coordinate spacing and locations with obstructions to ensure compliance with NFPA 13 standards for obstructions caused by lighting rigging equipment, lights, structural members, roof vents openings and ductwork, etc.

5. Fire Standpipe Supply Layout: Coordinate elevation and routing of piping to eliminate interference with work of other Prime Contractors.

C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified installer responsible for their preparation.

D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Building structural components.
2. Domestic water piping.
3. HVAC hydronic piping, ductwork and ceiling hung equipment.

4. Items penetrating finished ceiling include the following:

   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Fire Alarm sensors.

5. Details and sections to clarify design and installation to be in conformance with design criteria and standards described in this section.

6. Written statement that coordination has been accomplished with work of other Prime Contractors.

E. Qualification Data: For qualified Installer.

F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.

G. Welding certificates.

H. Fire-hydrant flow test report.

I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

J. Field quality-control reports.

K. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Applicable Standards: Sprinkler system equipment, specialties, accessories, design, installation, and testing shall comply with the following:

1. Fire Code of the City of Dover.
2. NFPA 13 Standard for the Installation of Sprinkler Systems - Latest edition, acceptable to City of Dover.
3. NFPA 14 Installation of Standpipe and Hose Systems - Latest edition, acceptable to City of Dover.
4. NFPA 24 Installation of Private Fire Service Mains and Their Appurtenances - Latest edition, acceptable to City of Dover.
5. Materials and devices essential for successful system operation shall be UL listed and FM approved.
6. International Building Code.
7. International Fire Code.

B. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of contractor obtained fire-hydrant flow test.

    a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified installer.

C. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to other facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Architect no fewer than five (5) working days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Architect's written permission.

1.9 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six (6) spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Schedule 10/40, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10/40 in NPS 6 and smaller; plain end.

B. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

C. Steel Couplings: ASTM A 865, threaded.

D. Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME 16.1, Class 125.

G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

H. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

I. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Anvil International, Inc.
   b. Corcoran Piping System Co.
   c. National Fittings, Inc.
   d. Shurjoint Piping Products.
   e. Tyco Fire & Building Products LP.
   f. Victaulic Company.

2. Pressure Rating: 175 psig minimum.
3. Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Anvil International, Inc.
   b. Victaulic Company.

2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
5. Valves NPS 3: Ductile-iron body with grooved ends.

C. Bronze Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Fivalco Inc.
   b. Global Safety Products, Inc.
   c. Milwaukee Valve Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

D. Iron Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Anvil International, Inc.
   b. Kennedy Valve; a division of McWane, Inc.
   c. Milwaukee Valve Company.
   d. NIBCO INC.
   e. Tyco Fire & Building Products LP.

f. Victaulic Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Cast or ductile iron.
5. Style: Lug or wafer.
6. End Connections: Grooved.

E. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.
b. Potter Roemer.
c. Reliable Automatic Sprinkler Co., Inc.
d. Tyco Fire & Building Products LP.
e. Viking Corporation.

2. Standard: UL 312.
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

F. Bronze OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. United Brass Works, Inc.

2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

G. Iron OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
b. Milwaukee Valve Company.
c. Mueller Co.; Water Products Division.

d. NIBCO INC.
e. Tyco Fire & Building Products LP.
f. Watts Water Technologies, Inc.

2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

H. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.
b. Kennedy Valve; a division of McWane, Inc.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Tyco Fire & Building Products LP.
f. Victaulic Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:

a. Valve Type: Ball or butterfly.
b. Body Material: Bronze.
c. End Connections: Threaded.

5. Valves NPS 2-1/2 and Larger:

a. Valve Type: Butterfly.
b. Body Material: Cast or ductile iron.
c. End Connections: Flanged, grooved, or wafer.

6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch indicating device.

I. NRS Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
b. American Valve, Inc.
c. Kennedy Valve; a division of McWane, Inc.
d. Mueller Co.; Water Products Division.
e. NIBCO INC.
f. Tyco Fire & Building Products LP.

2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast iron with indicator post flange.
5. Stem: Nonrising.
6. End Connections: Flanged or grooved.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Fire Protection Products, Inc.
b. United Brass Works, Inc.

C. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.
b. Fire-End & Croker Corporation.
c. Milwaukee Valve Company.
d. Potter Roemer.
e. Tyco Fire & Building Products LP.
f. Victaulic Company.

D. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Fire Protection Products, Inc.
b. United Brass Works, Inc.

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:

    a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.

3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Venus Fire Protection Ltd.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AFAC Inc.
    b. Reliable Automatic Sprinkler Co., Inc.
    c. Tyco Fire & Building Products LP.

2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.7 FIRE-DEPARTMENT CONNECTIONS

A. Storz-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Elkhart Brass Mfg. Company, Inc.
    b. Fire-End & Croker Corporation.
    c. Guardian Fire Equipment, Inc.
    d. Tyco Fire & Building Products LP.

2. Standard: UL 405.
3. Type: **Free-Standing Fire Department connection, with two-way inlet.**.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Forged aluminum adapter with galvanized steel elbow.

6. Inlets: 5” storz fitting according to NFPA and accepted by local fire-department. Include extension pipe caps.
7. Caps: Storz-type, with gasket and chain.
8. Escutcheon Plate: Flat on adapter.
9. Outlet: Back, with pipe threads.
10. Number of Inlets: **Two (2)**.
11. Escutcheon Plate Marking: Similar to "AUTO SPKR."
12. Finish: **Polished Chrome Plated.**
13. Outlet Size: NPS 4.

2.8 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Anvil International, Inc.
   b. National Fittings, Inc.
   c. Shurjoint Piping Products.
   d. Tyco Fire & Building Products LP.
   e. Victaulic Company.

2. Standard: UL 213.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AGF Manufacturing Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.

6. Inlet and Outlet: Threaded.

C. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Elkhart Brass Mfg. Company, Inc.
   b. Fire-End & Croker Corporation.
   c. Potter Roemer.

2. Standard: UL 199.
3. Pressure Rating: 175 psig.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AGF Manufacturing Inc.
   b. Triple R Specialty.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.
   e. Viking Corporation.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. CECA, LLC.
   b. Corcoran Piping System Co.
   c. Merit Manufacturing; a division of Anvil International, Inc.

2. Standard: UL 1474.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.

5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

F. Flexible, Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Fivalco Inc.
   b. FlexHead Industries, Inc.
   c. Gateway Tubing, Inc.

2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175 psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.9 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFAC Inc.
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.
4. Tyco Fire & Building Products LP.
5. Victaulic Company.
6. Viking Corporation.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Heads:

1. Concealed – Offices & Corridors Areas.

a. White Finish

2. Bronze – Mechanical Areas.

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed-type sprinklers.

1. Ceiling Mounting: Plastic, white finish, one piece, flat.
2. Sidewall Mounting: Plastic, white finish, one piece, flat.

F. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Reliable Automatic Sprinkler Co., Inc.
b. Tyco Fire & Building Products LP.
c. Victaulic Company.
d. Viking Corporation.

2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.10 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections. Coordinate with on-site Electrician.

B. Electrically Operated Alarm Bell:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Fire-Lite Alarms, Inc.; a Honeywell company.
b. Notifier; a Honeywell company.
c. Potter Electric Signal Company.

2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Size: 6-inch minimum- diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.

C. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ADT Security Services, Inc.

b. McDonnell & Miller; ITT Industries.
c. Potter Electric Signal Company.
d. System Sensor; a Honeywell company.
e. Viking Corporation.
f. Watts Industries (Canada) Inc.

2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

D. Pressure Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AFAC Inc.
b. Barksdale, Inc.
c. Potter Electric Signal Company.
d. System Sensor; a Honeywell company.
e. Tyco Fire & Building Products LP.
f. Viking Corporation.

2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

E. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Fire-Lite Alarms, Inc.; a Honeywell company.
b. Kennedy Valve; a division of McWane, Inc.
c. Potter Electric Signal Company.
d. System Sensor; a Honeywell company.

2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

2.11 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AMETEK; U.S. Gauge Division.
2. Ashcroft, Inc.
3. Brecco Corporation.
4. WIKA Instrument Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0 to 250 psig minimum.

E. Water System Piping Gage: Include "WATER" label on dial face.

2.12 BACKFLOW PREVENTOR

A. Double-Check, Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. FEBCO; SPX Valves & Controls.
   d. Flomatic Corporation.
   e. Watts Water Technologies, Inc.
   f. Zurn Plumbing Products Group; Wilkins Water Control Products Division.

2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: 3 psig maximum, through middle one-third of flow range.
5. Size: 4 NPS.
6. Design Flow Rate: 212 gpm.
7. Selected Unit Flow Range Limits: 0-500 gpm.
8. Pressure Loss at Design Flow Rate: 3-5 psig for NPS 2-1/2 and larger.
9. Body Material: Stainless steel for NPS 2-1/2 and larger.
10. End Connections: Flanged for NPS 2-1/2 and larger.
11. Configuration: Designed for horizontal flow.
12. Accessories: OS & Y gate valve with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

2.13 HOSE CONNECTIONS

A. Nonadjustable-Valve Hose Connections:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Elkhart Brass Mfg. Company Inc.
   b. Fire-End & Croker Corporation.
   c. Guardian Fire Equipment, Inc.
   d. Potter Roemer.
   e. Viking Corporation.

2. Standard: UL 668 hose valve for connecting fire hose.
3. Pressure Rating: 300 psig minimum.
4. Material: Brass or bronze.
5. Size: NPS 1-1/2, as indicated.
6. Inlet: Female pipe threads.
7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
8. Pattern: Gate.
9. Finish: Polished chrome-plated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 21 11 00 "Facility Fire-Suppression Water-Service Piping."

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 WATER-SUPPLY CONNECTIONS

A. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping.

B. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.4 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

M. Fill sprinkler system piping with water.

N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

O. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 21 05 18 "Escutcheons for Fire-Suppression Piping."

3.5 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.6 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.7 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels or in center of ceiling design pattern.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.8 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

3.9 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire-department connections.

B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.10 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.12 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.13 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.14 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control vales, instead of specified fittings.

C. Standard-pressure, wet-pipe sprinkler system, NPS 1-1/2 and smaller, shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2 and larger, shall be one of the following:

1. Schedule 10/40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
2. Schedule 10/40, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Schedule 10/40, black-steel pipe with plain ends; welding fittings; and welded joints.

3.15 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed white sprinklers.
3. Wall Mounting: Concealed sidewall sprinklers.
4. Special Applications: Extended-coverage, and quick-response sprinklers where indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.

END OF SECTION 21 13 13

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Definitions, references, and abbreviations.
2. General regulatory requirements.
3. General requirements regarding site/field conditions including existing conditions and field measurements.
4. Sequencing and scheduling including coordination.
5. Definition of design equipment and procedures for consideration of specified equivalents, proposed equivalents, or substitutions.
6. Piping materials and installation instructions common to most piping systems.
7. Transition fittings.
8. Grout.
9. Plumbing demolition.
10. Equipment installation requirements common to equipment sections.
11. Painting and finishing.
12. Concrete bases.
13. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

1.4 SYSTEM DESCRIPTION

A. Provide complete systems, properly connected, tested, balanced, adjusted, and ready for operation, including all necessary and required controls, safeties, details and accessories, including (but not limited to):

1. Site water and sanitary sewer utilities.
2. Sanitary drainage and vent systems.
3. Storm drainage and roof drainage systems.
4. Water distribution systems.
5. Water heating equipment.
6. Plumbing fixtures.
7. Electrical control wiring to equipment furnished in this Contract.
8. Electrical power wiring to equipment furnished in this Contract.

1.5 COORDINATION PROCEDURES

A. Coordinate construction operations and construction schedule of plumbing work in accordance with Section 01 31 00 “Project Management and Coordination” and as modified below.

1. Pre-Installation Conference:

a. Attend pre-installation conference. Arrange for all subcontractors to be in attendance.

2. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

3. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in "Access Doors and Frames."

4. Coordinate Plumbing Work with HVAC systems, lighting fixtures, ceiling mounted devices, ceiling heights, materials, structural work, maintenance clearances, and electric code clearance and building systems.

5. Notify Architect in case of unresolved interferences prior to installation of Plumbing Work.

6. Adjust exact size, location and offsets of pipes to achieve reasonable appearance objectives in open areas without ceilings, without increase in Contract Sum.

1.6 COORDINATION DRAWINGS

A. Comply with requirements of Section 01 31 00 “Project Management and Coordination” and as modified below.

1. Prepare drawings coordinating Plumbing Work with HVAC systems, lighting fixtures, ceiling mounted devices, ceiling heights, materials, structural work, maintenance clearances, electric code clearance, building systems, existing construction, etc. Provide additional details and sections, as required for clarity, at all places of potential conflict.

2. Reposition proposed locations of Plumbing systems as required to work within project constraints. Adjust exact size, aspect ratio, location and offsets of piping systems as required. Achieve as specified and other reasonable appearance objectives in open areas without ceilings without increase in Contract Sum.

3. Review Coordination Drawings and compare them with all other drawings to verify that all Work can be installed without interference. Notify Owner's Project Representative in case of unresolved interferences prior to installation of any work. Revise Coordination Drawings as required to eliminate installation interferences upon direction of Architect.

4. Indicate areas of unresolved conflicts between Plumbing systems and other building components by highlighting locations on Coordination Drawings and separately listing.

5. Do not proceed with installation of systems in each area until agreement is reached with all concerned on exact arrangements for each room or area, unless otherwise directed by Architect. If Contractor proceeds with installations prior to resolving conflicts, Contractor shall modify installed Work as required to permit other systems to proceed with a coordinated installation without an increase in Contract Sum.

6. Coordination Drawings do not relieve Contractor of responsibility for coordinating Plumbing system installations with Project work, nor does it authorize extra cost, omission or deviation from Contract Document requirements. Costs arising from errors or omissions in Coordination Drawings shall be borne by Contractor.

1.7 SUBMITTALS, GENERAL

A. General: Submit all action submittals required by this Section concurrently.

1.8 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sleeves and sleeve seals. Include rated capacities, and furnished specialties and accessories.
   1. Concrete mix for bases and supports.
   2. Grout.
   3. Sealants.
   4. Firestopping.
   5. Access doors.
   6. Paint.
   7. Dielectric fittings.
   8. Transition fittings.

B. Shop Drawings: Include dimensioned plans, sections, and attachments to other work for concrete bases.

1.9 INFORMATIONAL SUBMITTALS

A. Coordination Drawings.

B. Contract Closeout Submittals: Comply with requirements of Section 01 77 00 “Closeout Procedures”.

1.10 QUALITY ASSURANCE.

A. Provide installation, testing and materials in accordance with Federal, State and Local Building, Health, Plumbing and Electrical Codes, Laws, Ordinances, and Regulations that apply to Plumbing Work.

1. Comply with applicable requirements of following documents:

a. City of Dover Plumbing Code; International Plumbing Code (IPC).
b. In event of a conflict between the Codes identified above and Contract Documents, comply with more stringent requirement.

2. Comply with applicable Utility Company Regulations.

3. Obtain and pay for necessary inspections, certificates, and permits from applicable agencies. Perform required tests in accordance with regulation of agency having jurisdiction. Submit certificates of approval prior to the date of Substantial Completion as defined in Section 01 77 00 “Closeout Procedures”.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code-Steel."

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is submitted to the Architect and approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Packing and Shipping: Ship materials in manufacturer’s containers, fully identified with manufacture’s name, trade name, type, class, style, model, grade, size and color.

C. Storage and Protection:

1. Store materials, equipment, fixtures, pipe, fittings, and attachments, under cover, off ground in original containers as applicable, and protect from physical and weather damage while in storage and during construction.

2. Furnish extra materials identified in technical sections, in original manufacturers' containers and packaging, to Owner at location identified during prebid conference. Obtain receipt from Owner upon delivery of extra materials and send copy of receipt to Architect.

3. Replace or repair damaged, rusted, corroded or otherwise unusable materials physically damaged or weather damaged equipment as determined by Architect, at no change in Contract Sum.

1.12 PROJECT/SITE CONDITIONS

A. Existing Conditions:

1. Reuse equipment only as indicated on Drawings.

2. All usable material and equipment not being reused is to be offered to the Owner. If accepted by Owner the Contractor shall deliver to a location on Campus grounds designated by the Owner.

3. All other material and equipment to be removed, shall be removed from the site and legally disposed of by the Contractor

B. Rodent Proofing:

1. Strainer Plates: All strainer plates on drain inlets shall be designed and installed so that all openings are not greater than 0.5 inches in least dimension. Refer to Section 22 13 19 "Sanitary Waste Piping Specialties" and 22 14 23 "Storm Drainage Piping Specialties" for additional requirements.

2. Openings for Pipes: In or on structures where openings have been made in walls, floors or ceilings for the passage of pipes, such openings shall be closed and protected by the installation of approved metal collars that are securely fastened to the adjoining structure. Refer to Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing piping" and 22 05 18 "Escutcheons for Plumbing Piping" for additional requirements.

C. Protection of Plumbing Systems:

1. Corrosion: Provide corrosion protection for pipes passing through concrete or cinder walls and floors or buried in corrosive soil conditions.

a. Provide oversized sleeves or core drilled holes to eliminate rubbing on above grade piping installations. Refer to Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping" for pipe sleeve and core drilling requirements.

b. Refer to individual Division 22 piping Sections for corrosion protection on buried piping installations in corrosive soil conditions.

2. Stress and Strain: Install plumbing systems in a manner that prevents stresses and strains that exceed the structural strength of the pipe. Install piping systems to accommodate expansion, contraction and structural settlement.

3. Freezing: Do not install water, soil, waste or storm piping outside of a building, in attics or crawlspaces, conceal in outside walls or in any other place subjected to freezing temperatures without providing measures to keep the contents of the piping system from freezing.

D. Field Measurements:

1. Layout of equipment, piping, and similar components in Drawings is diagrammatic. Review Drawings to identify interference with other construction and verify dimensions at Site prior to beginning installation.

a. Obtain exact location of all items and openings and confirm all existing conditions in field.

b. Obtain exact location and roughing requirements for all equipment furnished by others, but installed by this Contractor before roughing. Owner reserves right to make reasonable changes prior to "roughing-in" without increase in Contract Sum.

2. Report any conflicts to Architect in writing before beginning installation.

3. Provide fittings, horizontal and vertical offsets, elevation changes, etc. required to install Plumbing Work. Do not infer that Drawings show level of detail indicating every offset, elbow, union, fitting, elevation changes, or other aspect required for complete installation.

4. Install Plumbing Work with proper provisions for removal and/or access to valves, traps, cleanouts, etc.

E. Furnish equipment and materials for Plumbing Work in conformance with Contract Documents, including any material, operation, method or device mentioned, listed or noted within Division 22 Sections, unless specified as furnished or installed by Prime Contractor(s) or others.

1.13 SEQUENCING AND SCHEDULING

A. Perform Plumbing Work in cooperation with Architect, and all Contractors on this Project, and other separate Contractors at the Site.

1. Coordinate Plumbing Work with construction schedule requirements in Division 01
2. Coordinate all submittals with the construction schedule and with requirements and schedules contained in Section 01 33 00 – Submittals Procedures.

3. Immediately report any delays in receipt of materials required for Plumbing Work including circumstances causing delays.

B. Refer to Division 01 for cooperation between Contractors. Prior to start of construction:

1. Obtain from Contract Drawings or Architect, exact location of items and openings in construction. Conform to existing conditions in field.

2. Submit Shop Drawings of all materials and equipment to Architect for review and acceptance.

3. If conflict occurs between Contract Drawings, advise Architect in writing before beginning installation and comply with Architect's directions.

4. Obtain exact location and roughing requirements for equipment furnished by other Contractor or by Owner, but installed by Contractor responsible for Plumbing Work before beginning roughing.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Minimum Material Requirements:

1. Construct potable water systems and equipment according to AWWA and IPC standards.

2. Provide electrical equipment and systems meeting UL standards and requirements of NEC.

3. Provide UL label on all equipment and material with listing service.

4. Material Flammability:

a. Flame spread rating of 25 or less.
b. Smoke developed rating of 50 or less.

5. Equipment Verification: Carefully check manufacturer's drawings and specifications as they affect their particular equipment; follow factory instructions for roughing, installation, connection, filling, lubrication, testing, balancing, adjusting, alignment, wiring, and start-up operation.

2.2 CONCRETE BASES AND SUPPORTS

A. Comply with requirements for concrete bases and supports specified in "Cast-in-Place Concrete."

2.3 GROUT

A. Description: ASTM C 1107, Grade B, non-shrink, non-metallic, high strength grout, suitable for interior and exterior, above and below grade applications.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.

3. Packaging: Premixed and factory packaged.

2.4 SEALANTS

A. Comply with requirements for sealants in non-fire rated penetrations specified in "Joint Sealants."

B. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include the following::

a. BASF Building Systems; Omniplus.
b. Dow Corning Corporation; 786 Mildew Resistant.
c. GE Advanced Materials - Silicones; Sanitary SCS1700.

2.5 FIRESTOPPING

A. Comply with requirements for sealants in fire rated penetrations specified in “Penetration Firestopping”.

2.6 ACCESS DOORS

A. Comply with requirements for access doors specified in “Access Doors and Frames” for product requirements.

B. Access Door Sizes for Plumbing Applications:

1. Single Valve :

a. 1-inch and Smaller Valve Size: 8 inches by 8 inches.
b. 1-1/2-inch and 2-inch Valve Size: 12 inches by 12 inches.
c. 3-inch and 4-inch Valve Size: 18 inches by 18 inches.

2. Two Valves :

a. 2-inch and Smaller Valve Size: 12 inches by 12 inches.
b. 3-inch and 4-inch Valve Size: 18 inches by 18 inches.

3. Condensate Drain Connection: 18 inches by 18 inches.
4. Other Devices: 12 inches by 12 inches.

2.7 PAINT AND FINISHES

A. Refer to painting and finishing specifications.

2.8 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.9 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.10 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Fittings:

1. Dielectric Unions:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Central Plastics Company.
2) Hart Industries International, Inc.
3) Matco-Norca, Inc.
4) McDonald, A. Y. Mfg. Co.
5) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
6) Wilkins; a Zurn Company.

b. Description:

1) Standard: ASSE 1079.

2) Pressure Rating: 125 psig minimum at 180 deg F.
3) End Connections: Solder-joint copper alloy and threaded ferrous.

2. Dielectric Flanges:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Capitol Manufacturing Company.
2) Central Plastics Company.
3) Matco-Norca, Inc.
4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
5) Wilkins; a Zurn Company.

b. Description:

1) Standard: ASSE 1079.
2) Factory-fabricated, bolted, companion-flange assembly.
3) Pressure Rating: 125 psig minimum at 180 deg F.
4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

3. Dielectric-Flange Insulating Kits:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Advance Products & Systems, Inc.
2) Calpico, Inc.
3) Central Plastics Company.
4) Pipeline Seal and Insulator, Inc.

b. Description:

1) Nonconducting materials for field assembly of companion flanges.
2) Pressure Rating: 150 psig.
3) Gasket: Neoprene or phenolic.
4) Bolt Sleeves: Phenolic or polyethylene.
5) Washers: Phenolic with steel backing washers.

2.11 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dresser, Inc.; Piping Specialties Products.
b. Ford Meter Box Company, Inc. (The).
c. JCM Industries.
d. Romac Industries, Inc.
e. Smith-Blair, Inc.; a Sensus company.
f. Viking Johnson.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

A. Refer to "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.

1. Remove Piping: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Remove Equipment: Disconnect and cap services and remove equipment.
3. Remove and Reinstall Equipment: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
4. Remove and Salvage Equipment: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is rendered unserviceable during the process of demolition, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Select system components with pressure rating equal to or greater than system operating pressure.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to section 22 05 29 “Hangers and Supports for Plumbing Piping and Equipment” for detailed additional requirements.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.6 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Refer to section 22 05 29 “Hangers and Supports for Plumbing Piping and Equipment” for detailed additional requirements.

B. National Design Specifications (NDS) criteria apply to all wood construction.

C. Do not use wood where it may compromise the fire resistance rating of the construction.

D. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.

E. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

F. Attach to substrates as required to support applied loads.

3.7 CONCRETE BASES

A. Refer to individual Division 22 piping and equipment Sections for specific concrete base and support requirements.

3.8 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.9 SEALANTS

A. Install sealants according to the requirements specified in "Joint Sealants."

B. Refer to individual Division 22 plumbing fixture and equipment Sections for specific sealant and caulking requirements.

3.10 FIRESTOPPING

A. Install firestopping according to the requirements specified in "Penetration Firestopping."

B. Applied Fireproofing:

1. Coordinate the installation of hangers, supports and accessories from the structural steel with the fireproofing installation. Install all hangers and supports prior to installation of fireproofing.
2. Repair or replace existing fireproofing removed as a part of Plumbing Work installation.

    a. Employ the services of an approved fireproofing contractor to repair or replace the fireproofing by patching any areas that have been removed or damaged due to the installation of work after the completion of the fireproofing.
    b. Repaired or replacement fireproofing shall match the fireproofing adjacent to the repaired area. All warranties shall be maintained.

3.11 ACCESS DOORS

A. Install access doors according to the requirements specified in "Access Doors and Frames."

B. Install access doors where shown on Drawings or where required for access to plumbing system components requiring service (i.e. valves, equipment, slip joints, unions, gauges, etc.) where located in concealed installations.

1. Install factory primed, flush access doors with exposed flanges in concealed installations not exposed to view (i.e. above lay-in ceilings and in Mechanical Rooms).

2. Install factory primed, flush access doors with concealed flanges access doors in painted gypsum board or plaster walls and/or ceilings exposed to view.

3. Install factory primed, flush access doors with concealed flanges in ceramic tile finished walls exposed to view.

4. Install fire rated, flush access doors with exposed flanges in fire rated walls or ceilings.

3.12 PAINTING

A. Painting of plumbing systems, equipment, and components is specified in "Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.13 DIELECTRIC FITTINGS

A. Install dielectric fittings according to the following requirements and Division 22 Sections specifying piping systems.

3.14 TRANSITION FITTINGS

A. Install transition fittings according to the following requirements and Division 22 Sections specifying piping systems.

END OF SECTION 22 05 00

SECTION 22 05 16 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Premanufactured expansion joints.
2. Pipe loops and swing connections.
3. Alignment guides and anchors.

1.3 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Flexible-hose packless expansion joints.
2. Alignment guides.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of expansion joint, from manufacturer.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 PACKLESS EXPANSION JOINTS

A. Flexible-Hose Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements provide products by one of the following:

   a. Flex-Hose Co., Inc.
   b. Flexicraft Industries.
   c. Flex Pression Ltd.
   d. Metraflex, Inc.
   e. Unisource Manufacturing, Inc.

2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.

3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.

4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.

   a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.

5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.

   a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.

2.2 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements provide products by one of the following:

   a. Flex-Hose Co., Inc.
   b. Flexicraft Industries.
   c. Flex-Weld, Inc.
   d. Hyspan Precision Products, Inc.
   e. Metraflex, Inc.
   f. Unisource Manufacturing, Inc.

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

   a. Stud: Threaded, zinc-coated carbon steel.
   b. Expansion Plug: Zinc-coated steel.
   c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

B. Install rubber packless expansion joints according to FSA-NMEJ-702.

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.

C. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.

D. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:
   1. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

   1. Anchor Attachment to Steel Structural Members: Attach by welding.
   2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 22 05 16

SECTION 22 05 17 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Firestopping.
4. Grout.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sleeves and sleeve seals. Include rated capacities, and furnished specialties and accessories.

1. Galvanized-steel sheet pipe sleeves.
2. Flanged galvanized-steel sheet pipe sleeves.
3. Firestopping.
4. Grout.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Galvanized-Steel Sheet: 0.0359-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Flanged Galvanized-Steel Sheet: 0.1345-inch minimum thickness; round tube closed with welded longitudinal joint with 2-inch minimum wide anchor flange welded to perimeter of sleeve. Set flange on perimeter of sleeve to obtain minimum of 2 inches concrete embedment.

2.2 FIRE STOPPING

A. Comply with requirements for firestopping specified in "Penetration Firestopping."

B. Provide premium products specified for each application as appropriate. Submit Product Data for all proposed firestopping materials with schedule of applications for review and approval.

2.3 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.

3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in "Joint Sealants."

C. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in "Penetration Firestopping."

3.3 SLEEVE SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Concrete Masonry Unit (CMU) Partitions: Flanged galvanized-steel sheet sleeves with joint sealant.

2. Interior Metal Stud Partitions: Galvanized-steel sheet sleeves with joint sealant.

a. In lieu of joint sealant, provide penetration firestopping at the following locations:

1) Penetrations in fire-resistance-rated walls.
2) Penetrations in smoke barriers.

3.4 GROUTING

A. Mix and install grout for plumbing sleeves and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout around sleeves and anchors.

F. Cure placed grout.

END OF SECTION 22 05 17

SECTION 22 05 18 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for escutcheons.

1. One-piece, cast-brass type escutcheon.
2. One-piece, deep-pattern type escutcheon.
3. One-piece, stamped-steel type escutcheon.
4. Split-casting brass type escutcheon.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Beginning installation constitutes Contractor's acceptance of substrates and conditions.

3.2 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern type with polished, chrome-plated finish and spring clip fastener.
2. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
3. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
4. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
5. Bare or Insulated Piping in Unfinished Service Spaces and Equipment Rooms: No escutcheons required.

3.3 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons using new materials.

END OF SECTION 22 05 18

SECTION 22 05 19 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Thermometers.
2. Gages.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Plastic-case, industrial-style, adjustable liquid-in-glass thermometers.
2. Thermowells.
3. Direct-mounted, dial-type pressure gages.
4. Snubbers.
5. Valves.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Plastic-Case, Industrial-Style, Adjustable Liquid-in-Glass Thermometers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Weiss Instruments, Inc; Vari-angle Model 9VU Series or product by one of the following:

a. Ernst Flow Industries.
b. Tel-Tru Manufacturing Company.

c. Trerice, H. O. Co.

B. Standard: ASME B40.200.

C. Case: GE Valox® polyester, 40 percent glass/mineral reinforced; 9-inch nominal size unless otherwise indicated.

D. Case Form: Adjustable angle unless otherwise indicated.

E. Tube: Glass with magnifying lens and blue organic liquid.

F. Tube Background: Non-reflective aluminum with white matte finish and black scale markings graduated in deg F.

G. Window: Glass.

H. Stem: Die cast Zamac alloy and of length to suit installation.
1. Design for Thermowell Installation: Bare stem.

I. Connector: 1-1/4 inches, with ASME B1.1 screw threads.

J. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: Brass or stainless steel.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length required to match thermometer bulb or stem.
9. Lagging Extension: Include on thermowells for insulated piping and tubing.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

A. Direct-Mounted, Dial-Type Pressure Gages:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Weiss Instruments, Inc.; Series PG-1 or product by one of the following:

   a. Ernst Flow Industries.
   b. Tel-Tru Manufacturing Company.
   c. Trerice, H. O. Co.

2. Standard: ASME B40.100.
3. Case: Liquid-filled, sealed, solid-front, pressure relief type(s); black impact resistant phenolic; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Non-reflective aluminum with white matte finish and black scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Safety glass lens.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

B. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees.

C. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

D. Install thermowells with extension on insulated piping.

E. Fill thermowells with heat-transfer medium.

F. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install valve and snubber in piping for each pressure gage for fluids.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

B. Locate and adjust reading angle of nearby and groups of thermometers, i.e. multiple temperature water heating systems thermometers, so that multiple readings can be made easily from floor level and from one location.

C. Locate and adjust reading angle of thermometers to be read from floor level without obstructions.

3.4 THERMOMETER SCHEDULE

A. Install an industrial-style, liquid-in-glass type thermometers at the following locations:

1. Inlet and outlet of each domestic water heater.

B. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Water Piping: 30 to 180 deg F.

3.6 PRESSURE-GAGE SCHEDULE

A. Install liquid-filled sealed solid-front, pressure-relief, direct-mounted, metal case pressure gages at the following locations:

1. Water service piping at point of entry into building.
2. Inlets and outlets of each water service backflow preventer.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 100 psi.

B. Scale Range for Domestic Water Piping: 0 to 100 psi.

END OF SECTION 22 05 19

SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Bronze swing check valves.
3. Bronze globe valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene copolymer rubber.
C. NBR: Acrylonitrile-butadiene, NBR, or nitrile rubber.

1.4 SUBMITTALS, GENERAL

A. General: Submit all action submittals required by this Section concurrently.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated:

1. Two-Piece Bronze ball valves.
2. Three-Piece Bronze ball valves.
3. Bronze swing check valves.
4. Bronze globe valves.

1.6 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.
4. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Handwheel: For valves other than quarter-turn types.
2. Handlever: For quarter-turn valves NPS 6 and smaller[**except plug valves**].

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Solder Joint: With sockets according to ASME B16.18.
2. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim (NPS 2 and smaller):

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO INC.; Model S-585-70-66-NS or T-585-70-66-NS or a product by one of the following:

   a. Conbraco Industries, Inc.; Apollo Valves.
   b. Hammond Valve.
   c. Milwaukee Valve Company.
   d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-110.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Bronze.
   f. Ends: Soldered or threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Stainless steel.
   i. Ball: Stainless steel, vented.
   j. Port: Full.

B. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim (NPS 2-1/2" and smaller):

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO INC.; Model S-585-70-66-NS or T-585-70-66-NS or a product by one of the following:

   a. Conbraco Industries, Inc.; Apollo Valves.
   b. Hammond Valve.
   c. Milwaukee Valve Company.

2. Description:

   a. Standard: MSS SP-110.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Three piece.
   e. Body Material: Bronze.
   f. Ends: Soldered or threaded.

g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

C. BRONZE SWING CHECK VALVES

D. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO INC.; Model S-413-W or T-413-W or a product by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Powell Valves.

2. Description:

a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 200 psig.
c. Body Design: Y-pattern horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded or solder.
f. Disc: NBR.

2.3 BRONZE GLOBE VALVES

A. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO INC.; Model S-235-Y or T-235-Y or a product by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Powell Valves.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded or solder.
e. Stem: Copper-silicon bronze.
f. Disc: PTFE or TFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

F. Beginning installation constitutes Contractor's acceptance of substrates and conditions.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball or butterfly valves.
2. Throttling Service: Ball or butterfly valves.
3. Check Valves:

    a. NPS 2 and Smaller: Bronze swing check valves with nonmetallic disc.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two or three piece, full port, brass with stainless-steel trim.
3. Bronze Swing Check Valves: Class 125, nonmetallic disc.

END OF SECTION 22 05 23

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Threaded rod.
   2. Adjustable steel clevis hangers.
   3. Adjustable swivel-ring band hangers.
   4. Hinged pipe clamps.
   5. Pipe stanchion saddles.
   6. Adjustable pipe saddle supports.
   7. Riser clamps.
   8. C-Clamps.
   9. Insulation shields.

B. Shop Drawings: Show fabrication and installation details for the following; include Product Data for components:

   1. Trapeze pipe hangers.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria.

   1. Detail fabrication and assembly of trapeze hangers.
   2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.

3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carpenter & Paterson, Inc.
2. ERICO International Corporation.
3. National Pipe Hanger Corporation.
4. PHS Industries, Inc.
5. Piping Technology & Products, Inc.
6. Rilco Manufacturing Co., Inc.

B. Description: MSS SP-58, Type 40, factory-fabricated components.

C. Galvanized Metallic Coatings: Pregalvanized or hot dipped.

D. Insulation-Insert Material for Piping Support: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

K. Insulated Piping:

1. Attach clamps and spacers to piping.
   a. Use thermal-hanger shield insert with clamp sized to match OD of insert.
   b. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

3. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

4. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.3 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in "Interior Painting."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.5 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and attachments for general service applications.

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 1 1/4.
3. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 1 1/4.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.

2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
4. C-Clamps (MSS Type 23): For structural shapes.
5. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
6. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
7. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
8. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.

9. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
10. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
11. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
2. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 05 29

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment and piping labels.
2. Valve tags and signage.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals and informational submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For the following products:

1. Warning signs/labels.
2. Pipe labels.
3. Stencils.
4. Valve tags.
5. Valve function signage.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.5 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

1. Water Service Piping on exposed water service piping exceeding 10 feet in length prior to backflow preventer device: “Feed Line to Backflow Preventer – DO NOT TAP.”

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.3 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
2. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.4 VALVE TAGS

A. Valve Tags: 1-1/2 inches diameter, stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 VALVE FUNCTION SIGNAGE

A. Plastic Signage:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Signage Content: Include valve's unique verbiage where indicated on Drawings, unless otherwise specified.

1. Stop and drain valves serving an exterior wall hydrant: Text to read “Wall Hydrant Shutoff Valve and Drain Plug”.
2. Bypass valves: Text to read “Bypass Valve-Normally Closed”.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

C. Provide nameplates for equipment with identifying name of equipment and function.

D. Provide name plates for panels identifying name of panel and function, function of switches, control devices, panel lights, and buttons and securely fasten to panels.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in "Painting."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Architect's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, and plenums; and locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 12 feet along each run. Reduce intervals to 6 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

1. Domestic Cold Water Piping:

   a. Background Color: Green.
   b. Letter Color: Black.

2. Domestic Hot Water Piping:

   a. Background Color: Yellow.
   b. Letter Color: Black.

3. Sanitary Waste Piping:

   a. Background Color: Yellow.
   b. Letter Color: Black.

4. Storm Drainage Piping:

   a. Background Color: Green.
   b. Letter Color: Black.

E. Water Service Piping: Provide Piping Identification Labels on exposed water service piping exceeding 10 feet in length prior to backflow preventer device at 5 foot intervals. Text to read "Feed Line to Backflow Preventer - DO NOT TAP". Each main and branch shutoff valve.

F. Trap Primer Water Piping: Provide Piping Identification Labels on exposed water piping between trap primers and drain connections exceeding 10 feet in length at 5 foot intervals. Text to read “Non-potable Water”.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Color: Natural.

2. Letter Color: Black.

C. Provide valve tag for each piping systems valve located above grade.

1. Valve Directory: Provide neat typewritten directory listing valve function, location and identification number.

2. Valve Numbering System: Extension of and compatible with existing valve numbering system, where valves are installed in existing building or in addition to existing building.

3. Verification: Verify existing valve numbers in field and provide valve numbering avoiding duplication of existing numbers.

3.5 VALVE FUNCTION SIGNAGE INSTALLATION

A. Provide signage and wording as indicated.

B. Securely fasten to valve using self-locking nylon fasteners.

END OF SECTION 22 05 53

SECTION 22 07 19 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

1. Flexible elastomeric insulation.
2. Mineral-fiber, preformed pipe insulation.
3. Mineral-fiber, hydraulic-setting insulating and finishing cement.
4. Mineral-fiber adhesive.
5. Vapor-barrier mastic.
6. Sealants.
7. Factory-applied jackets.
8. ASJ tape.
9. PVC tape.
10. Protective shielding pipe covers.
11. Protective shielding piping enclosures.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," and articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide products by one of the following:

a. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

G. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide products by one of the following:

a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000-Degree Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, provide products by one of the following:

   a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide products by one of the following:

   a. Aeroflex USA, Inc.; Aeroseal.
   b. Armacell LLC; Armaflex 520 Adhesive.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
   d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide products by one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
   b. Eagle Bridges - Marathon Industries; 225.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
   d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide products by one of the following:

a. Dow Corning Corporation; 739, Dow Silicone.
b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
b. Eagle Bridges - Marathon Industries; 501.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
d. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

2.5 SEALANTS

A. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide products by one of the following:

    a. Johns Manville; Zeston.
    b. P.I.C. Plastics, Inc.; FG Series.
    c. Proto Corporation; LoSmoke.
    d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

    a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and roof drain bodies.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide products by one of the following:

   a. ABI, Ideal Tape Division; 428 AWF ASJ.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
   c. Compac Corporation; 104 and 105.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide products by one of the following:

   a. ABI, Ideal Tape Division; 370 White PVC tape.
   b. Compac Corporation; 130.
   c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.8 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide products by one of the following:

   a. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping and Seals.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015 inch thick, 3/4 inch wide with wing seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. C & F Wire.

2.9 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers,:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Engineered Brass Company.
   b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
   c. McGuire Manufacturing.
   d. Plumberex.
   e. Truebro; a brand of IPS Corporation.
   f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
3. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

C. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies.
3. Comply with requirements in "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
6. Install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
7. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping.
2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold, Hot and Recirculation Water Piping (General Building Areas):

1. Mineral-Fiber, Preformed Pipe Insulation with factory applied jacket, Type I: 1 inch thick.

B. Domestic Cold, Hot and Recirculation Water Piping located within Masonry Block Walls:

1. Flexible Elastomeric Insulation: 1/2 inch thick.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. Protective Shielding Pipe Covers.

D. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch thick.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Piping, Exposed:

1. PVC: 30 mils thick.

END OF SECTION 22 07 19

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for combined water service and fire-service mains.

B. Contractor shall furnish and install all mains, hydrants, valves and fittings as specified and indicated on the drawings.

C. All water and wastewater utility construction and materials to be dedicated to the City shall be performed by a contractor approved by the city and to the standards and specifications issued by the city. This includes review and approval by the City of shop drawings and materials. Comply with the *City of Dover Water and Wastewater Handbook.*

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure Ratings: Except where otherwise indicated, the following are minimum pressure requirements for water system piping.

1. Underground Piping: 150 psi (1035 kPa).
2. Underground Piping, Fire Suppression System: 200 psig (1380 kPa).

B. Protection of Potable Water Supply:

1. A minimum of 10 feet horizontal separation shall be provided between proposed water mains and proposed sewers.
2. Clearances: Where specified crossing clearance cannot be obtained, sewer shall be encased in concrete for 10 feet each side of water main. For crossings of other utilities, sewer shall be encased with limits of the utility trench.

   a. Sewer crossing water mains shall have a clearance of 18 inches below water main or shall be encased.
   b. Sewers shall have a minimum of 6 inches clearance when crossing other utilities.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

C. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

D. Field quality-control test reports.

E. Record drawings at Project closeout of installed water system piping and products according to Division 1 Section "Project Closeout."

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Comply with AWWA C151 for selection, design, and installation of ductile iron water piping.

D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

F. NSF Compliance:

1. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

G. Provide listing/approval stamp, label, or other marking on equipment made to specified standards

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.

2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify Construction Manager Owner & Municipality no fewer than five days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without Construction Manager's & Municipality’s written permission.

B. Verify that water system piping may be installed in compliance with original design and referenced standards.

C. Site Information: Reports on subsurface condition investigations made during the design of the Project are available for informational purposes only; data in reports are not intended as representations or warranties of accuracy or continuity of conditions (between soil borings). Owner and Architect assumes no responsibility for interpretations or conclusions drawn from this information

1.8 COORDINATION

A. Coordinate connection to water main with utility company.

B. Coordinate connection to Building Plumbing and other Division 22 work.

C. Coordinate with other utility work including but not limited to fire protection systems piping.

D. Coordinate electrical requirements of actual equipment furnished with requirements specified in Division 26.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type K, water tube, drawn temper.

B. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.

C. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.2 DUCTILE-IRON PIPE AND FITTINGS

A. Push-on-Joint, Ductile-Iron Pipe: Class 52, AWWA C151, cement lined with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.
3. Standard joint length shall be 18’-20’.

B. Mechanical-Joint, Ductile-Iron Pipe: Class 52, AWWA C151, cement lined with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
3. Standard joint length shall be 18’-20’.

C. Flanges: ASME 16.1, Class 125, cast iron.

D. Comply with NFPA 24 and local/state regulations for fire-service mains.

2.3 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Split-Sleeve Pipe Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Victaulic Depend-O-Lok.

2. Description: Metal, bolted, split-sleeve-type, reducing or transition coupling with sealing pad and closure plates, O-ring gaskets, and bolt fasteners.

a. Standard: AWWA C219.
b. Sleeve Material: Stainless steel.
c. Sleeve Dimensions: Of thickness and width required to provide pressure rating.
d. Gasket Material: O-rings made of EPDM rubber, unless otherwise indicated.
e. Pressure Rating: 200 psig minimum.
f. Metal Component Finish: Corrosion-resistant coating or material.

C. Flexible Connectors:

1. Nonferrous-Metal Piping: Bronze hose covered with bronze wire braid; with copper-tube, pressure-type, solder-joint ends or bronze flanged ends brazed to hose.
2. Ferrous-Metal Piping: Stainless-steel hose covered with stainless-steel wire braid; with ASME B1.20.1, threaded steel pipe nipples or ASME B16.5, steel pipe flanges welded to hose.

D. Tracer wire:

1. Minimum 12 gauge blue coated solid copper wire.

E. Retaining Glands

1. High strength ductile iron conforming to ASTM A536, Grade 65-45-12.
2. Wedging mechanism of heat treated ductile iron with 370 BHN hardness
3. Glands shall be per ANS1/AWWA A21.11/C111 and ANSI AWWA A21.53/C153.
4. Minimum working pressure rating to be 350 psi.

2.4 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Provide valves by Mueller, Model 2360 or a comparable product approved by the Municipality/Utility.

2. Nonrising-Stem, Resilient-wedge epoxy coated Gate Valves:

a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.

1) Standard: AWWA C509.
2) Minimum Pressure Rating: 200 psig .
3) End Connections: Mechanical joint.
4) Interior Coating: Complying with AWWA C550.

2.5 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Manufacturers: Subject to compliance with requirements of the municipality/utility, provide products by one of the following:
2. Provide Powerseal 3490AS or a comparable product approved by the utility.
3. Description: Sleeve and valve compatible with drilling machine.

    a. Standard: AWWA C115.
    b. Tapping Sleeve: Stainless-steel type 304 (18-8), two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with stainless flange for branch valve.
    c. Bolts & Nuts: type 304 (18-8) stainless per ASTM A193 and A194.

4. Valve: AWWA C509 epoxy coated, resilient wedge, NSF 61 certified. cast-iron, nonrising-stem, with one raised face flange mating tapping-sleeve flange. Mueller A-2360T or equal approved by Municipality.

B. Valve Boxes: Cast iron three piece screw type box. Provide Tyler Union 6860 series. Include top section, extra deep lid with two holes, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel 5 1/4 inches in diameter.

1. Provide boxes by Tyler, or a comparable product approved by the utility.
2. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
3. All boxes for 4, 6, and 8-inch valves shall be equipped with #6 round base. 10-inch valves shall be used with #8 valve box base. Valve boxes shall be adjustable between 2’-4” and 3’-4” except when deeper settings are required.

2.6 CORPORATION VALVES AND CURB VALVES

A. Manufacturers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Mueller Co. Water Products Division; model number per utility company standard for service line size.

B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.

1. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet with outlet matching service piping material.
2. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.

C. Curb Valves: Comply with AWWA C800. Include bronze body, or ball, and wide tee head, with inlet and outlet matching service piping material.

D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 4 1/4 inches in diameter.

1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2. Provide Tyler Union 6500 or approved equal by City.

2.7 WATER METERS

A. Water meter will be purchased from the Municipality/utility company within the base bid.

B. Meter to be 1 ½” Sensus Omni T2 with Itron ERT.

C. Contractor to install meter with pit and appurtenances

D. Meter pit to be Mueller/Hunt EZ-vault meter setter with angle valve at meter entrance and Mueller H-14460-A dual check valve at meter outlet.

2.8 FIRE HYDRANTS

A. Dry-Barrel Fire Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide the following:

a. Darling Co. B-62-B Breakaway

2. Description: Freestanding, with one NPS 41/4 and two NPS 2-1/2 outlets, Threads shall match those presently used in the Utilities system, nozzles shall be connected to the upper barrel by means of a quarter turn system and held in place with a 304 stainless steel screw, 5-1/4-inch main valve, drain valve, and NPS 6 mechanical-joint inlet. Include interior coating according to AWWA C550. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.

a. Standard: AWWA C502.
b. All hydrants to be furnished with non-kinking chains on the 2 ½-inch nozzles.
c. Caps and operating nut shall have the “DOVER SPECIAL” taper.

3. A sworn certificate of inspection and testing shall be furnished by the manufacturer. Install hydrants with restraint system as detailed on the drawings, or with a hydrant tee.

2.9 CONCRETE METER VAULTS

A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857 and made according to ASTM C 858. Dimensions of vault shall be to provide required clearance per City’s Water/Wastewater handbook.

1. Ladder: ASTM A 36/A 36M, steel or polyethylene-encased steel steps.
2. Manhole: ASTM A 48/A 48M Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.

    a. Dimension: 24-inch minimum diameter, unless otherwise indicated.

3. Manhole: ASTM A 536, Grade 60-40-18, ductile-iron traffic frame and cover.

    a. Dimension: 24-inch- minimum diameter, unless otherwise indicated.

2.10 FIRE DEPARTMENT CONNECTIONS

A. Fire Department Connections:

1. Manufacturers: Subject to compliance with requirements of the DE State Fire Marshal and local health department and match local fire department threads.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall contact the City of Dover Public Utilities Construction & Inspections Manager at (302) 736-7070 prior to start of construction.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Underground Combined Water-Service and Fire-Service-service piping shall be any of the following:

1. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed joints.
2. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products
3. Installation shall be coordinated with and overseen by the fire protection contractor.

3.3 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults as indicated in utility

company details. Use UL/FMG, non-rising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.

B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, resilient-seated gate valves with valve box.
2. Use the following for valves in vaults and aboveground:

   a. Gate Valves, NPS 3 and Larger: AWWA, cast iron, OS&Y rising stem, resilient seated.

3. Relief Valves: Use for water-service piping in vaults and aboveground.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated except where deviations to layout are approved on coordination drawings.

B. Install piping at indicated slope.

C. Install restrained joints for buried piping within 5 feet (1.5m) of building. Use restrained-joint pipe and fittings, thrust blocks, anchors, tie-rods and clamps, and other supports at vertical and horizontal offsets.

D. Install piping free of sags and bends.

E. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

F. Install fittings for changes in direction and branch connections.

3.5 PIPING INSTALLATION

A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.

B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.

C. Make connections larger than NPS 2 with tapping machine according to the following:

1. Install tapping sleeve and tapping valve according to MSS SP-60.
2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.

4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

D. Make connections NPS 2 and smaller with drilling machine according to the following:

1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
4. Install corporation valves into service-saddle assemblies.
5. Install manifold for multiple taps in water main.
6. Install curb valve in water-service piping with head pointing up and with service box.

E. Comply with NFPA 24 for fire-service-main piping materials and installation.

1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
2. Install copper tube and fittings according to CDA's "Copper Tube Handbook."

F. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

G. Bury piping with depth of cover over top at least 48 inches, with top at least 12 inches below level of maximum frost penetration, and according to the following:

H. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

I. Each section of pipe shall be placed on a solid foundation for its full length, with recesses excavated to accommodate the bell of the pipe. Any pipe which has its grade or joint disturbed after installation shall be removed and reinstalled. No pipe shall be installed on frozen or wet subgrade. Bedding material shall be provided per the City of Dover Water/Wastewater Handbook DWG WW-16.

J. The interior of the pipe shall be thoroughly cleaned of all foreign matter before being lowered into the trench, and shall be kept clean during laying operations by means of plugs or other approved methods. Under no circumstances shall pipe be laid in water, and no pipe shall be laid when trench or weather conditions are unsuitable for such work.

K. At all times work is not in progress, all open ends of pipe and fittings shall be securely closed so that no trench water, earth or other substance will enter the pipe or fittings.

L. Any section of pipe in place and found to be defective shall be removed and replaced immediately at no cost to the Owner.

M. No section of pipe shall be installed with deflection greater than manufacturer’s recommendations either vertically or horizontally. Any deviation required to be greater than recommended shall be made with a special fitting.

N. All installation of ductile iron pipe shall be in accordance with AWWA Standard No. C600 with tracer wire and detector tape.

O. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping to within 5, of building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

P. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

Q. See Division 21 Section "Water-Based Fire-Suppression Systems" for fire-suppression-water piping inside the building.

R. See Division 22 Section "Domestic Water Piping" for potable-water piping inside the building.

3.6 JOINT CONSTRUCTION

A. Make pipe joints according to the following:

1. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.7 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.
2. Set-screw mechanical retainer glands.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
2. Fire-Service-Main Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.8 VALVE & VALVE BOX INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

C. Valve boxes shall be installed at each outside valve. Boxes shall be sufficient length to provide a cover of not less than two feet over the pipe. Valve boxes shall be set plumb, and placed directly over the valve. Valve boxes shall be placed on two, 4-inch solid concrete blocks. After being correctly positioned, each fill shall be carefully tamped around the valve box for a distance of four (4) feet on all sides of the box. Any box found out of plumb or settled shall be reset at no cost to the Owner.

3.9 WATER METER INSTALLATION

A. Install water meters, piping, and specialties according to utility company's written instructions.

3.10 ROUGHING-IN FOR WATER METERS

A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

3.11 FIRE HYDRANT INSTALLATION

A. General: Install each fire hydrant as required by the Municipality/utility company per detail. Provide with separate gate valve in supply pipe, anchor If no detail provided, use restrained joints or thrust blocks. Support hydrant in upright position.

B. AWWA Fire Hydrants: Comply with AWWA M17.

C. Hydrant leads shall be ductile iron.

3.12 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install ball drip valves at each check valve for fire department connection to mains.

B. Install protective pipe bollards as required by local fire marshal at each fire department connection. Pipe bollards are specified in Division 05 Section "Metal Fabrications."

3.13 FIELD QUALITY CONTROL

A. Piping Tests: The Contractor shall furnish all equipment, labor, and materials, including water, pumps, compressors, stopwatch, gauges, and meters for testing. The Municipality shall determine the amount of main to be tested at any one time and reserves the right to separate the installation into several test sections. All tests must be witnessed by the Construction Manager or Owner.

B. Domestic Water Main Hydrostatic Tests: Test at not less than 165 psi, whichever is greater, for two hours.

1. Test Pressure shall:

a. Be not less than 165 psi for water mains and not less than 200 psi for fire mains.

b. Be of at least two hour duration
c. Result in no variation

2. Pressurization:

a. Each valved section of pipe shall be filled with water slowly and the specified test pressure, based on the elevation of the lowest point of the line or section under the test and corrected to the elevation of the test gauge shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Owner.

3. Air Removal:

a. Before applying the specified test pressure, air shall be expelled completely from the pipe, valves and hydrants. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points, so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, all corporation cocks shall be removed and plugged, or left in place at the discretion of the Owner.

4. Examination:

a. All exposed pipe, fittings, valves, hydrants and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with same material and the test shall be repeated until it is satisfactory to the Owner.

C. Prepare reports of testing activities.

3.14 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by Municipality/utility company and authorities having jurisdiction including the Delaware Department of Health. Procedure shall be as described in AWWA C652.
3. If method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C652 or do as follows:

a. Upon completion of water main construction, disinfect main and appurtenances. Disinfection shall be done in accordance with ANSI/AWWA C-651, latest edition. Contractor shall submit a plan of disinfection for approval by the Architect.

b. After the applicable retention period, the heavily chlorinated water shall be flushed from the main. This water shall be discharged to the sanitary sewer system. Only

after water leaving the main is no higher in chlorine concentration than normal drinking water, will a discharge to storm drains be allowed. Convey flushed water to discharge point in a closed system.

c. Affidavits of compliance, certifying the water sampled from the water mains to be free of coliform bacteria, shall be submitted to the Architect. The Contractor is responsible for requesting tests from the Delaware Department of Public Health. He shall provide written documentation when a section of mains can be placed in service.

d. The Contractor shall place in each length of pipe, hydrants, hydrant branches, and other appurtenances, a sufficient amount of HTH tablets to insure adequate disinfection treatment of the main after its completion. Tablets shall be fastened to the inside top of every length of pipe as laid, using gasket cement known as "Permatex No. 2".

e. The Contractor will be held entirely responsible for securing a minimum residual chlorine content of 5 p.p.m. at the extremities of the mains after twenty-four (24) hours or more contact with the full water pressure on the main.

f. Water for filling the mains shall be introduced at a velocity of less than one (1) foot per second in order to permit the HTH or Perchloron to completely dissolve and have a reasonable uniform distribution throughout the mains. It is the intent of this Specification to require a sufficient amount of chemical to be equivalent to a dosage of 50 p.p.m. of chlorine.

g. After the chlorine has been in contact with the mains or storage units for twenty-four (24) hours or longer, samples collected from the extremities of the mains shall indicate a residual chlorine content of 5 p.p.m. or more.

h. If less than 5 p.p.m. residual chlorine is indicated, the system shall be drained and the disinfection treatment repeated.

i. If samples collected at the extremities indicate a residual chlorine of 5 p.p.m. or more, the system shall be flushed until there is only a normal chlorine residual (1.0 p.p.m. or less) present, as determined by the DPD Method Test. Samples of water shall be collected from various points along the lines, by a lab certified in the State of Delaware for bacteriological analysis. If satisfactory bacteriological results are obtained, the lines may then be allowed to be placed in service. A copy of all test results shall be submitted to the Architect.

4. Contractor shall provide all disinfection testing within the lump sum prices bid.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Aboveground domestic water pipes, tubes, and fittings inside buildings.

B. Related Requirements:

1. Section 22 11 13 "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Copper tube and fittings.
2. Solder.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

C. Lab results for biological testing showing samples negative for coliform bacteria.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Refer to Section 01 10 00 “Summary” and Section 01 12 00 “Multiple Contract Summary” for requirements associated with interrupting the existing water service to facilities occupied by the Owner.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

2.4 TRANSITION FITTINGS

A. Install transition couplings at joints of piping with small differences in OD's. Refer to transition fitting products specified in Section 22 05 00 “Common Work Results for Plumbing”.

2.5 DIELECTRIC FITTINGS

A. Dielectric Unions and Flanges: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined. Comply with requirements in Section 22 05 00 "Common Work Results for Plumbing."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before proceeding with water piping installation, examine conditions existing at Site and notify affected Architect of any construction or any other conditions prevailing which prevent, inhibit, or otherwise interfere with water piping installation.

B. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install shutoff valve, hose-end drain valve, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 22 11 19 "Domestic Water Piping Specialties."

C. Install shutoff valve immediately upstream of each dielectric fitting.

D. Install domestic water piping level without pitch and plumb.

E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

H. Install piping to permit valve servicing.

I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

J. Install piping free of sags and bends.

K. Install fittings for changes in direction and branch connections.

L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

M. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 22 05 19 "Meters and Gages for Plumbing Piping."

N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

F. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

A. Comply with requirements for transition fittings specified in Section 22 05 00 "Common Work Results for Plumbing."

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.5 DIELECTRIC FITTING INSTALLATION

A. Comply with requirements for dielectric fittings specified in Section 22 05 00 "Common Work Results for Plumbing."

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or unions.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS –SP-69, Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: MSS –SP-69, Type 1, adjustable, steel clevis hangers.
3. Base of Vertical Piping: MSS-SP-69, Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.

G. Install supports for vertical steel piping every 15 feet.

H. Support piping and tubing not listed in this article according to MSS-SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

    1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
    2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Above Grade Piping Tests:

    a. Initial Test:

        1) Do not connect fixtures, equipment and solenoid valves into system during this test.
        2) Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
        3) Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
        4) Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
        5) Cap and subject piping to static water pressure of 150 psig, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
        6) Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
        7) Prepare reports for tests and for corrective action required.

    b. Test After Fixtures are Connected:
        1) Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
        2) Test system again for 2 hours at 75 psig or prevailing water pressure, whichever is higher.
        3) Repair leaks and defects at fixture and equipment connections or at solenoid valves, and retest piping or portion thereof until satisfactory results are obtained.

4) Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
5. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Fill and isolate system according to either of the following:

1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

a. After contact period, flush all parts of system with clear water until system tests at no more than 0.2-PPM residual chlorine.
b. After contact period, flush all parts of system with clear water until system tests at no more than 0 PPM residual chlorine.
c. Repeat procedures if biological examination shows contamination.
d. Have samples analyzed by a State Certified testing lab. Submit copy of results to Architect showing samples test negative for coliform bacteria.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.

3.13 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller.
2. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 22 11 16

SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Mixing valves.
4. Hose bibbs and hydrants.
5. Water-hammer arresters.
6. Air vents.
7. Trap-seal primers.
8. Specialty valves.
9. Flexible connectors.

B. Regulatory Requirements:

1. Backflow Preventers: Provide devices complying with applicable provisions and listed as approved by Delaware State Department of Health, and Human Resources, Bureau of Public Water Supply approved Backflow Prevention Assemblies and the International Plumbing Code (IPC).

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for domestic water piping specialties. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1. Hose-connection vacuum breakers.
2. Pressure vacuum breakers.
3. Double-check backflow-prevention assemblies.
4. Water control valves.
5. Primary, thermostatic, water mixing valves.
6. Y-pattern strainers.

7. Hose bibbs.
8. Nonfreeze wall hydrants.
9. Hose-end drain valves.
10. Stop-and-waste drain valves.
11. Automatic air vents.
12. Trap-seal primer device.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 and NSF 14.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Hose-Connection Vacuum Breakers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company; Model NF8C or a product by one of the following:

a. Conbraco Industries, Inc.
b. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1011.

3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

B. Pressure Vacuum Breakers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company; Model 800M4QT or a product by one of the following:

   a. Conbraco Industries, Inc.
   b. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Size: 3/8 or 1/2 NPS.
6. Design Flow Rate: 3-5 gpm.
7. Selected Unit Flow Range Limits: 0-6 gpm.
8. Pressure Loss at Design Flow Rate: 7 psig.
9. Accessories:

   a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers, Boiler Supply:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company; Model 909 or a product by one of the following:

   a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
   b. Conbraco Industries, Inc.
   c. FEBCO; a division of Watts Water Technologies, Inc.
   d. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 15 psig maximum, through middle 1/3 of flow range.
5. Size: 1 NPS.
6. Design Flow Rate: 5 gpm.
7. Selected Unit Flow Range Limits: 0-20 gpm.
8. Pressure Loss at Design Flow Rate: 12.5 gpm.
9. Body: Bronze.
10. End Connections: Threaded.
11. Configuration: Designed for horizontal, straight through flow.

12. Accessories:

    a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller.
    b. Air-Gap Fitting: Watts Model 909-AG-C ASME A112.1.2, matching backflow-preventer connection.

B. Double-Check Backflow-Prevention Assemblies, Building Supply:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company; Model 007 or a product by one of the following:

    a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
    b. Conbraco Industries, Inc.
    c. FEBCO; a division of Watts Water Technologies, Inc.
    d. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 4 psig maximum, through middle 1/3 of flow range.
5. Size: 2 NPS.
6. Design Flow Rate: 80 gpm.
7. Selected Unit Flow Range Limits: 0-80 gpm.
8. Pressure Loss at Design Flow Rate: 4 psig.
9. Body: Bronze.
10. End Connections: Threaded.
11. Configuration: Designed for horizontal, straight through flow.
12. Accessories:

    a. Valves: Quarter-turn, full port, resilient seated ball valves.
    b. Strainer: Bronze strainer.

2.5 TEMPERATURE-ACTUATED, WATER MIXING VALVES

1. Basis-of-Design Product: Subject to compliance with requirements, provide Powers; a division of Watts Water Technologies, Inc: Model e427 or a product by one of the following:

    a. Conbraco Industries, Inc.
    b. Leonard Valve Company.
    c. Symmons Industries, Inc.
    d. TACO Incorporated.
    e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled exposed-mounted, water mixing valve.

5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 110 deg F.
9. Tempered-Water Design Flow Rate: 6 gpm.
10. Valve Finish: Rough bronze.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:

    a. Strainers NPS 2 and Smaller: 0.020 inch.

6. Drain: Factory-installed, hose-end drain valve.

2.7 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.8 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Basis-of-Design Product: Subject to compliance with requirements, Josam Co.: Model No. 71000 or product by one of the following:

   a. J. R. Smith Mfg. Co.
   b. MIFAB, Inc.
   c. Tyler Pipe; Wade Div.
   d. Watts Drainage Products.
   e. Woodford Manufacturing Company; a division of WCM Industries, Inc.
   f. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.

2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker, backflow preventer and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Polished nickel bronze box, satin stainless steel hinged latching cover.
10. Outlet: Exposed, with integral vacuum breaker backflow preventer and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): Two with each wall hydrant.

2.9 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Stop-and-Waste Drain Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Conbraco Industries, Inc.; Apollo Valves; Series No. 95-200-27 or product by one of the following:

    a. Hammond Valve.
    b. Milwaukee Valve Company.
    c. NIBCO Inc.
    d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Standard: MSS SP-110 for ball valves.
3. Pressure Rating: 200-psig minimum CWP or Class 125.
4. Size: NPS 3/4.
5. Body: Copper alloy or ASTM B 62 bronze.
6. Drain: NPS 1/8 side outlet with cap.

2.10 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc; 5200 series “Hydrotrol Junior” or comparable product by one of the following:

    a. Josam Company.
    b. MIFAB, Inc.
    c. Precision Plumbing Products, Inc.
    d. Sioux Chief Manufacturing Company, Inc.
    e. Watts Drainage Products.
    f. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

2. Standard: ASSE 1010 or PDI-WH 201.

3. Type Copper tube with multiple “O” ring pistons.

4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.11 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.12 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Precision Plumbing Products, Inc., Model PR-500 Prime Rite or product by one of the following:

   a. MIFAB, Inc.
   b. Sioux Chief Manufacturing Company, Inc.

2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
8. Distribution Unit: Multiple gravity drain connections for servicing multiple floor drains.

2.13 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Hyspan Precision Products, Inc.
4. Mercer Gasket & Shim, Inc.
5. Metraflex, Inc.
6. Proco Products, Inc.

B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3.

2.14 SPECIALTY VALVES

A. Comply with requirements for general-duty metal valves in Section 22 05 23 "General-Duty Valves for Plumbing Piping."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

C. Install Y-pattern strainers for water on supply side of each control valve.

D. Install water-hammer arresters in water piping according to PDI-WH 201.

E. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

F. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.2 CONNECTIONS

A. Comply with requirements for ground equipment in "Grounding and Bonding for Electrical Systems."

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Reduced-pressure-principle backflow preventers.
3. Double-check, backflow-prevention assemblies.
4. Primary, thermostatic, water mixing valves.
5. Supply-type, trap-seal primer valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, and double-check, backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 22 11 19

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Hub-and-spigot, cast-iron soil pipe and fittings
2. Hubless, cast-iron soil pipe and fittings
3. CISPI, low torque hubless-piping couplings
4. Heavy-duty, high torque hubless-piping couplings
5. Galvanized-steel pipe and fittings
6. Copper pipe and fittings
7. Transition couplings.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Provide pipe and fittings produced by a single manufacturer for each type of system.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Sewer: Refer to Section 01 10 00 “Summary” for requirements associated with interrupting the existing sanitary sewer service to facilities occupied by the Owner.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: Centrifugally cast gray cast iron pipe and static cast fittings conforming to requirements of ASTM Standard A 74, service weight (SV) and extra heavy weight (XH) type with coating on interior and exterior in accordance with ANSI/AWWA C104/A21.4. Pipe and fittings marked with the collective trademark of the Cast Iron Soil Institute and listed by NSF® International.

B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: Centrifugally cast gray cast iron pipe and static cast fittings conforming to requirements of ASTM A 888 or CISPI with coating on interior and exterior in accordance with ANSI/AWWA C104/A21.4. Pipe and fittings marked with the collective trademark of the Cast Iron Soil Institute and listed by NSF® International.

B. CISPI, Low Torque Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

a. ANACO-Husky.
b. Fernco Inc.

c. MIFAB, Inc.
d. Mission Rubber Company; a division of MCP Industries, Inc.
e. Tyler Pipe.

2. Standards: ASTM C 1277 and CISPI 310.

3. Description: Type 301 stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, High Torque Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ANACO-Husky.
b. Clamp-All Corp.
c. Dallas Specialty & Mfg. Co.
d. MIFAB, Inc.
e. Mission Rubber Company; a division of MCP Industries, Inc.
f. Stant.
g. Tyler Pipe.

2. Standards: ASTM C 1277 and ASTM C 1540.

D. Description: Type 304 stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include threaded ends matching joining method.

B. Galvanized-Cast-Iron Drainage Fittings: ASME B16.12, threaded.

C. Steel Pipe Pressure Fittings:

1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.

2.5 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.

D. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.

E. Copper Pressure Fittings:

1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.6 TRANSITION FITTINGS

A. Install transition couplings at joints of piping with small differences in OD's. Refer to transition fitting products specified in Section 22 05 00 “Common Work Results for Plumbing”.

2.7 DIELECTRIC FITTINGS

A. Dielectric Unions and Flanges: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined. Comply with requirements in Section 22 05 00 "Common Work Results for Plumbing."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine conditions under which drainage and vent systems, e.g., storm drainage, sanitary sewer, etc., are to be installed in coordination with Installer of materials

and components specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

1. Verify invert elevation of existing piping when new connections are indicated. Do not install buried sewer work until existing sewer invert elevation has been verified to meet required slope and bury depth requirements of new sewer piping.

2. Determine inverts and routing of piping systems and interferences with other building piping systems, building structure, lights, ductwork, foundations prior to installation.

B. Beginning installation constitutes Contractor's acceptance of substrates and conditions.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install vent piping to allow application of insulation within 6 feet of a roof penetration.

I. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping

upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

K. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

M. Install steel piping according to applicable plumbing code.

N. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."

O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Comply with requirements for transition and dielectric fittings specified in Section 22 05 00 "Common Work Results for Plumbing."

B. Transition Couplings:

1. In Drainage Piping: Shielded, nonpressure transition couplings.
2. In Aboveground Force Main Piping: Fitting-type transition couplings.

C. Dielectric Fittings:

1. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
2. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or flange kits.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install galvanized carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install galvanized carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Vertical Piping: MSS Type 8 or Type 42, clamps.
4. Install individual, straight, horizontal piping runs:

   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

5. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.

J. Install supports for vertical copper tubing every 10 feet.

K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.

2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Comply with requirements for cleanouts, and drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, and at final connection to each piece of equipment.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wc. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil, waste and vent piping NPS 3 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Galvanized-steel pipe, drainage fittings, and threaded joints.
4. Copper DWV tube, copper drainage fittings, and soldered joints.
5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Aboveground, soil, waste and vent piping NPS 4 and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Underground, soil, waste, and vent piping NPS 12 and smaller shall be the following:

1. Extra Heavy Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

END OF SECTION 22 13 16

SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Miscellaneous sanitary drainage piping specialties.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

B. HDPE: High-density polyethylene plastic.

1.4 SUBMITTALS, GENERAL

A. General: Submit all action submittals and informational submittals required by this Section concurrently.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Exposed metal cleanout tee.
2. Floor cleanouts, general building areas.
3. Floor cleanouts, boiler rooms and mechanical room areas.
4. Wall cleanout tee.
5. Floor drain “A”.
6. Floor-drain, trap-seal primer fittings.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.8 COORDINATION

A. Coordinate size and location of roof penetrations.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanout Tee (CO):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.; No. 4512-S Series or a comparable product by one of the following:

   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Tyler Pipe; Wade Div.
   d. Watts Drainage Products Inc.
   e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, bronze plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Floor Cleanouts, General Building Areas (CODP):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.; No. 4021-U Series or product by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Watts Drainage Products Inc.
    d. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M, for adjustable housing cleanouts.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule Material: Cast iron.
6. Outlet Connection: Spigot.
7. Closure: Bronze plug with straight threads and gasket or plastic plug and gasket.
8. Adjustable Housing Material: Nickel-bronze with threads.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated, vandal resistant top.
10. Frame and Cover Shape: Round.
11. Top-Loading Classification: Medium Duty.
12. Carpet Clamping Collar: Required in carpeted areas.
13. Riser: ASTM A 74, Extra-Heavy or Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Floor Cleanouts, Boiler Rooms and Mechanical Room Areas (HD CODP):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.; No. 4220-U-G Series or product by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Watts Drainage Products Inc.
    d. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M, for adjustable housing cleanouts.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule Material: Cast iron.
6. Outlet Connection: Spigot.
7. Closure: Bronze plug with straight threads and gasket or plastic plug and gasket.
8. Adjustable Housing Material: Galvanized cast iron with threads.
9. Frame and Cover Material and Finish: Galvanized cast iron with scoriated, vandal resistant top.
10. Frame and Cover Shape: Round.
11. Top-Loading Classification: Heavy Duty.

12. Riser: ASTM A 74, Extra-Heavy or Service class, cast-iron drainage pipe fitting and riser to cleanout.

D. Wall Cleanout Tee (COWP):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.; No. 4531-U or product by one of the following:

   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Watts Drainage Products Inc.
   d. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
3. Size: Same as connected drainage piping.
4. Body Material: Hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure: Countersunk, drilled-and-threaded bronze plug and gasket.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with vandal resistant screw.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains – Type “A”:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.; No. 2005-A or a product by one of the following:

   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Watts Drainage Products Inc.
   d. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Not required.
12. Top or Strainer Material: Nickel bronze.

13. Top of Body and Strainer Finish: Nickel bronze.
14. Top Shape: Round.
15. Dimensions of Top or Strainer: 8” diameter, adjustable strainer, standard sump, standard grate.
16. Top Loading Classification: Light Duty.
17. Funnel: Not required.
18. Inlet Fitting: Not required.
19. Trap Material: Cast iron.
20. Trap Pattern: Standard P-trap.
21. Trap Features: Cleanout and trap-seal primer valve drain connection.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

H. Install wood-blocking reinforcement for wall-mounting-type specialties.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 13 19

SECTION 22 14 23 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Miscellaneous storm drainage piping specialties.
2. Cleanouts.
3. Through-penetration firestop assemblies.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Exposed metal cleanouts.
2. Floor cleanouts, general building areas.
3. Floor cleanouts, boiler rooms and mechanical room areas.
4. Wall cleanouts.
5. Exterior cleanouts.
6. Through-penetration firestop assemblies.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanout Tee (CO):

1. Vertical 6 NPS and Smaller:

a. Basis-of-Design Product: Subject to compliance with requirements, Jay R. Smith Mfg. Co.; No. 4512-S Series or a comparable product by one of the following:
1) Josam Company.
2) MIFAB, Inc.
3) Tyler Pipe; Wade Div.
4) Watts Drainage Products Inc.
5) Zurn Plumbing Products Group; Specification Drainage Operation.

b. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
c. Size: Same as connected drainage piping
d. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
e. Closure: Countersunk or raised-head, brass plug.
f. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

2. 8-inch Pipe Size and Larger: Cast bronze tapered plug with tapped test tee cast iron fitting.

3. Horizontal: All Pipe Sizes: Cast iron Tee “Y” fitting with tapped spigot ferrule and cast bronze taper thread plug.

B. Floor Cleanouts, General Building Areas (CODP):

1. Basis-of-Design Product: Subject to compliance with requirements, provide J.R. Smith Mfg. Co.; No. 4021-U Series or comparable product by one of the following:

a. Josam Company.
b. Watts Water Technologies, Inc.
c. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M, for adjustable housing cleanouts.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule Material: Cast iron.
6. Outlet Connection: Spigot.
7. Closure: Brass plug with straight threads and gasket or plastic plug and gasket.
8. Adjustable Housing Material: Nickel-bronze with threads.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated, vandal resistant top.

10. Frame and Cover Shape: Round.
11. Top-Loading Classification: Medium Duty.
12. Carpet Clamping Collar: Required in carpeted areas.
13. Riser: ASTM A 74, Extra-Heavy or Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Floor Cleanouts, Boiler Rooms and Mechanical Room Areas (HD CODP):

1. Basis-of-Design Product: Subject to compliance with requirements, provide J.R. Smith Mfg. Co.; No. 4220-U-G Series or comparable product by one of the following:

    a. Josam Company.
    b. Watts Water Technologies, Inc.
    c. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M, for adjustable housing cleanouts.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule Material: Cast iron.
6. Outlet Connection: Spigot.
7. Closure: Brass plug with straight threads and gasket or plastic plug and gasket.
8. Adjustable Housing Material: Galvanized cast iron with threads.
9. Frame and Cover Material and Finish: Galvanized cast iron with scoriated, vandal resistant top.
10. Frame and Cover Shape: Round.
11. Top-Loading Classification: Heavy Duty.
12. Riser: ASTM A 74, Extra-Heavy or Service class, cast-iron drainage pipe fitting and riser to cleanout.

D. Wall Cleanouts (COWP):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith Mfg. Co.; No. 4531-U or comparable product by one of the following:

    a. Josam Company.
    b. MIFAB, Inc.
    c. Watts Water Technologies, Inc.
    d. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
3. Size: Same as connected drainage piping.
4. Body Material: Hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure: Countersunk, drilled-and-threaded bronze plug and gasket.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with vandal resistant screw.

2.2 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. ProSet Systems Inc.

2. Standard: ASTM E 814, for through-penetration firestop assemblies.
3. Certification and Listing: Intertek Testing Service NA for through-penetration firestop assemblies.
4. Size: Same as connected pipe.
5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
7. Special Coating: Corrosion resistant on interior of fittings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Beginning installation constitutes Contractor's acceptance of substrates and conditions.

B. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate cleanouts at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

F. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.

G. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Section “Facility Storm Drainage Piping”. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 14 23

SECTION 22 16 23 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping and tubing joining materials.
3. Valves.
4. Pressure regulators.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. PE: Polyethylene

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 100 psig minimum unless otherwise indicated.
3. Minimum Operating Pressure of Service Meter: 2 psig.

B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less.

C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified installer, using performance requirements and design criteria indicated.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Valves. Include pressure rating, capacity, settings of selected models.
3. Pressure regulators. Indicate pressure ratings and capacities.
4. Dielectric fittings.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1. Shop Drawing Scale: 1/4 inch per foot.
2. Detail mounting, supports, and valve arrangements for service meter assembly and pressure regulator assembly.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

B. Qualification Data: For qualified installer.

C. Welding certificates.

D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pressure regulators to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Regulatory Requirements:

1. Install gas equipment, piping materials and provide testing in accordance with the International Fuel Gas Code, applicable American National Standards Institute (ANSI) code and NFPA 54 - National Fuel Gas Code, and rules and regulations of local gas company.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

1.10 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

   a. Material Group: 1.1.
   b. End Connections: Threaded or butt welding to match pipe.
   c. Lapped Face: Not permitted underground.
   d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
   e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

   a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

6. Mechanical Couplings:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Dresser Piping Specialties; Division of Dresser, Inc.
      2) Smith-Blair, Inc.

   b. Stainless-steel flanges and tube with epoxy finish.
   c. Buna-nitrile seals.
   d. Stainless-steel bolts, washers, and nuts.
   e. Coupling shall be capable of joining steel pipe to steel pipe.

2.2 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 MANUAL GAS SHUTOFF VALVES

A. See "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

   1. CWP Rating: 125 psig.
   2. Threaded Ends: Comply with ASME B1.20.1.
   3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
   4. Tamperproof Feature: Locking feature for valves indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
   5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
   6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

   1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO INC.; Model T-595-Y-UL or comparable product by one of the following:

a. BrassCraft Manufacturing Company; a Masco company.
b. Conbraco Industries, Inc.; Apollo Div
c. Lyall, R. W. & Company, Inc.
d. McDonald, A. Y. Mfg. Co.
e. Perfection Corporation; a subsidiary of American Meter Company.

2. CWP Rating: 175 psig.
3. Body: Bronze, complying with ASTM B 584.
4. Ball: Chrome-plated brass.
5. Stem: Bronze; blowout proof.
6. Seats: Reinforced PTFE; blowout proof.
7. Packing: Threaded-body packnut design with adjustable-stem packing.
8. Threaded Ends: Comply with ASME B1.20.1.
9. Listing by UL, CSA, or agency acceptable to authorities having jurisdiction for valves 1 inch and smaller.
10. Valves 1-1/4 inch and larger shall be suitable for natural-gas service service, with "WOG" indicated on valve body.

D. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. McDonald, A. Y. Mfg. Co.
b. Mueller Co.; Gas Products Div.
c. Xomox Corporation; a Crane company.

2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Flowserve.
b. Homestead Valve; a division of Olson Technologies, Inc.
c. McDonald, A. Y. Mfg. Co.
d. Milliken Valve Company.
e. Mueller Co.; Gas Products Div.

f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.

2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.4 Nameplates: Permanent type and legible labeling custom engraved sign black plastic nameplate with engraved white letters, of size sufficient to include applicable legible wording, with mounting holes; similar to "Setonply" by Seton Nameplate Company. Punched tape nametags not acceptable.

2.5 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller.

B. Service Pressure Regulators: Comply with ANSI Z21.80.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Fisher Control Valves and Regulators; Division of Emerson Process Management, or product by one of the following:

a. Actaris.
b. American Meter Company.
c. Invensys.
d. Richards Industries; Jordan Valve Div.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.

8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 100 psig.

C. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Fisher Control Valves and Regulators; Division of Emerson Process Management, or product by one of the following:

   a. Actaris.
   b. American Meter Company.
   c. Eclipse Combustion, Inc.
   d. Invensys.
   e. Maxitrol Company.
   f. Richards Industries; Jordan Valve Div.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 2 psig.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined. Refer to Section 22 05 00 "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Beginning installation constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 and the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 12 inches below finished grade. Comply with requirements in Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

D. Install fittings for changes in direction and branch connections.

E. Install pressure gage downstream from each service regulator. Pressure gages are specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

3.4 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Locate valves for easy access.

G. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Verify final equipment locations for roughing-in.

K. Comply with requirements in Sections specifying gas-fired equipment for roughing-in requirements.

L. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

M. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

N. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

O. Connect branch piping from top or side of horizontal piping.

P. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

Q. Do not use natural-gas piping as grounding electrode.

R. Install strainer on inlet of each line-pressure regulator.

S. Install pressure gage downstream from each line regulator. Pressure gages are specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.5 SERVICE-METER ASSEMBLY INSTALLATION

A. Install service-meter assemblies aboveground.

B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.

C. Install strainer on inlet of service-pressure regulator and meter set.

D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.

E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.

F. Install service meters downstream from pressure regulators.

G. Install metal bollards to protect meter assemblies. Comply with requirements in "Metal Fabrications" for pipe bollards.

3.6 VALVE INSTALLATION

A. Install underground valves with valve boxes.

B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.7 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

3.8 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.

3.9 CONNECTIONS

A. Install natural-gas piping electrically continuous, and bonded to gas equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

B. Install piping adjacent to equipment to allow service and maintenance of equipment.

C. Connect piping to equipment using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired equipment. Install union between valve and equipment.

D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.10 LABELING AND IDENTIFYING

A. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.11 PAINTING

A. Comply with requirements in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting" for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, and piping specialties, except components with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Exterior alkyd enamel (flat).
d. Color: Safety yellow.

C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, and piping specialties, except components, with factory-applied paint or protective coating.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.

2. Alkyd System: MPI INT 5.1E.

a. Prime Coat: Quick-drying alkyd metal primer.
b. Intermediate Coat: Interior alkyd matching topcoat.
c. Topcoat: Interior alkyd (flat).
d. Color: Safety yellow.

D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Install, test and purge gas lines in accordance with NFPA 54 and the International Fuel Gas Code, gas utility company standards, or other authority having jurisdiction, and with additional testing criteria as described in following:

a. Above Grade Piping Systems:

1) Do not connect fixtures, equipment and solenoid valves into system during this test.
2) Subject building's new natural gas piping system to oil-free and dry air or inert gas at pressure of 1½ times the working pressure or 50-psig, whichever is greater. Isolate test source and let stand for 4 hours to equalize temperature. Refill piping system if necessary, to test pressure for 2 hours with no pressure drop.

b. Buried Ferrous Piping: Subject buried steel gas piping system to air pressure of 1½ times the working pressure or 100-psig, whichever is greater, for 2 hours with no leakage during entire test period.

2. Provide additional tests as required and specified by the local jurisdictional authority.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports, to the Architect.

3.13 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be the following:

1. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.

B. Aboveground natural-gas piping shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

A. Aboveground, branch piping NPS 1 and smaller shall be the following:
1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

3.15 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG

A. Aboveground, branch piping NPS 2 and smaller shall be the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be the following:

   1. Steel pipe with malleable-iron fittings and threaded joints.
   2. Steel pipe with steel welding fittings and welded joints.

3.16 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Distribution piping valves for pipe sizes NPS 2 and smaller shall be the following:

   1. Three-piece, full-port, bronze ball valves with bronze trim.

B. Valves in branch piping for single equipment shall be the following:

   1. Three-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 22 16 26

SECTION 22 33 00 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Commercial, electric, storage, domestic-water heaters.
2. Domestic-water heater accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of commercial, electric, domestic-water heater, from manufacturer.

B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

C. Source quality-control reports.

D. Field quality-control reports.

E. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including storage tank and supports.
    b. Faulty operation of controls.
    c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

    a. Commercial, Electric, Storage, Domestic-Water Heaters:

        1) Storage Tank: Three (3) years.
        2) Controls and Other Components: Three (3) years.

    b. Expansion Tanks: Five (5) years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Commercial, Electric, Storage, Domestic-Water Heaters – Building Supply:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide State Industries, Co. product or acceptable substitution by one of the following:

      a. A. O. Smith Corporation
      b. American Water Heaters.
      c. Bradford White Corporation.
      d. Lochinvar Corporation.
      e. Rheem Manufacturing Company.
      f. Ruud Manufacturing Co.

   2. Standard: UL 1453.
   3. Storage-Tank Construction: ASME-code, steel vertical arrangement.

      a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.

         1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.

      b. Pressure Rating: 150 psig .
      c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.

   4. Factory-Installed Storage-Tank Appurtenances:

      a. Anode Rod: Replaceable magnesium.
      b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
      c. Insulation: Comply with ASHRAE/IESNA 90.1.
      d. Jacket: Steel with enameled finish.
      e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
      f. Temperature Control: Adjustable thermostat.
      g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
      h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

   5. Special Requirements: NSF 5 construction.

B. Capacity and Characteristics:

1. Capacity: 50 gal.
2. Recovery: 61 gph at 100 deg F temperature rise.
3. Temperature Setting: 140 deg F.
4. Power Demand: 6.0 kilowatts.
5. Heating Elements:

    a. Number of Elements: Three.
    b. Kilowatts Each Element: 2.0 kilowatts.
    c. Number of Stages: One.

6. Electrical Characteristics:

    a. Volts: 240.
    b. Phases: Three.
    c. Hertz: 60.
    d. Full-Load Amperes: 14.4.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:

1. Basis-of-Design Product: Subject to compliance with requirements, provide AMTROL Inc.; Therm-X-Trol ASME Model No. ST-5-C or comparable product by one of the following:

    a. Armstrong Pumps Inc.
    b. Bell & Gossett Domestic Pump; ITT Corporation.
    c. Wessels Company.
    d. Wood, John Co.

2. Description: ASME-code, steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
3. Construction:

    a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
    b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
    c. Air-Charging Valve: Factory installed.

4. Capacity and Characteristics:

    a. Working-Pressure Rating: 150 psig.
    b. Capacity Acceptable: 2 gal. minimum.
    c. Air Precharge Pressure: 50 psig.

B. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

C. Heat-Trap Fittings: ASHRAE 90.2.

D. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

E. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

F. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester. Comply with requirements for water hammer arresters as specified in Section 22 11 19 "Domestic Water Piping Specialties."

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in "Cast-in-Place Concrete."

1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
2. Maintain manufacturer's recommended clearances.
3. Arrange units so controls and devices that require servicing are accessible.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Anchor domestic-water heaters to substrate.

B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 22 05 23 "General-Duty Valves for Plumbing Piping."

C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 22 11 19 "Domestic Water Piping Specialties."

E. Install thermometers on inlet and outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

F. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

G. Fill electric, domestic-water heaters with water.

H. Charge domestic-water expansion tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 01 40 00 "Quality Requirements" for retesting and reinspecting requirements and Section 01 73 00 "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, electric, domestic-water heaters.

END OF SECTION 22 33 00

SECTION 22 42 13.13 - COMMERCIAL WATER CLOSETS

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Water closets.
2. Flushometer valves.
3. Toilet seats.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1. Water Closet: Floor mounted, top spud.
2. Water Closet: Accessible floor mounted, top spud.
3. Hard-wired flushometer valves.
4. Toilet seats.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Water Conservation:

1. Provide plumbing fixtures and accessories, including installation, complying with applicable provisions of International Plumbing Code, and City of Dover Plumbing Code.
2. Provide plumbing fixtures complying with applicable provisions of the Plumbing Code of the City of Dover.

B. ADA - Americans with Disabilities Act Requirements: Provide plumbing fixtures and installations complying with Federal Register volume 75, No. 207, Rules and Regulations, where indicated.

1.7 EXTRA MATERIALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

PART 2 - PRODUCTS

2.1 GENERAL CHARACTERISTICS

A. Vitreous China: Unmarked, true and level, clear, smooth and bright. Warranted not to craze, color or scale.

B. Trap ways no less than 2-1/8 inches in diameter and fully glazed.

C. Water surface area no less than 10 inches x 12 inches.

D. 100 percent factory tested for hydraulic performance, and trap seal depth, meeting or exceeding ANSI/ASME Standard A112.19.6, CSA B45 and a minimum ball pass diameter of 2 inches.

2.2 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

A. Water Closets: Floor mounted, top spud.

1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard; Madera No. 3451.712 closet and flushometer system, or product by one of the following:

   a. Kohler Co.
   b. Sloan Valve Company.
   c. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Bowl:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Type: Siphon jet.
d. Style: Flushometer valve.
e. Height: 14-1/8 inch inch rim elevation.
f. Rim Contour: Elongated.
g. Water Consumption: 1.28 gal. per flush.
h. Spud Size and Location: NPS 1-1/2; top.
i. Outlet: Bottom.
j. Color: White.

3. Bowl-to-Drain Connecting Fitting: ASME A112.4.3.

B. Water Closets: Accessible floor mounted, top spud.

1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard ; Madera Right Height No. 3461.712 closet and flushometer system, or product by one of the following:

a. Kohler Co.
b. Sloan Valve Company.
c. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Bowl:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Type: Siphon jet.
d. Style: Flushometer valve.
e. Height: 17-1/4 inch rim elevation.
f. Rim Contour: Elongated.
g. Water Consumption: 1.28 gal. per flush.
h. Spud Size and Location: NPS 1-1/2; top.
i. Outlet: Bottom.
j. Color: White.

3. Bowl-to-Drain Connecting Fitting: ASME A112.4.3.

2.3 FLUSHOMETER VALVES

A. Battery Powered Flushometer Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard closet and flushometer system units as listed in Article 2.2, or comparable product by the following:

a. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include angle stop bumper, sweat solder adapter, cast set screw escutcheon, casing tube, integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Style: Exposed.
8. Actuator: Solenoid complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
9. Trip Mechanism: Hard-wired electronic sensor complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
10. Consumption: 1.28 gal. per flush.
11. Minimum Inlet: NPS 1.
12. Minimum Outlet: NPS 1-1/4.
13. Power Supply: From concealed enclosure, 120 VAC to 6 VDC, per Manufacturer's instructions.

2.4 TOILET SEATS

A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard America.
   b. Bemis Manufacturing Company.
   c. Church Seats.
   d. Kohler Co.
   e. Olsonite Seat Co.
   f. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Standard: IAPMO/ANSI Z124.5, UL 94V0.
3. Material: Anti-microbial treated fire retardant plastic.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Self-sustaining, check.
7. Hinge Material: Non-corroding metal.
8. Seat Cover: Not required.
9. Color: White.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.

B. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install actuators in locations that are easy for people with disabilities to reach.
4. Power enclosures to be provided by the Electrical Contractor per the flushometer manufacturer’s instructions.

C. Install toilet seats on water closets.

D. Wall Flange and Escutcheon Installation:

1. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
2. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
3. Install escutcheon so set screw is facing floor.

E. Joint Sealing:

1. Comply with sealant requirements specified in "Joint Sealants."
2. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
3. Match sealant color to water-closet color.

3.3 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Coordinate electronic-sensor power supply enclosures with Electrical and General Contractors.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

END OF SECTION 22 42 13.13

SECTION 22 42 13.16 - COMMERCIAL URINALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Urinals.
2. Flushometer valves.
3. Supports.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for urinals. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1. Urinal: Top spud.
2. Hard-wired flushometer valves.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

PART 2 - PRODUCTS

2.1 WALL-HUNG URINALS

A. Urinals: Top spud.

1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard: Washbrook Model No. 6501.615 urinal and flushometer system, or comparable product by one of the following:

a. Kohler Co.
b. Sloan Valve Company.
c. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Fixture:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Type: Siphon jet with extended shields.
d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
e. Water Consumption: 1.0 gal. per flush.
f. Spud Size and Location: NPS 3/4; top.
g. Outlet Size and Location: NPS 2; back.
h. Color: White.

3. Waste Fitting:

a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
b. Size: NPS 2.

4. Support:

a. Standard: ASME A112.6.1M.
b. Description: Type I, urinal carrier with top and bottom fixture support plates, coupling with seal and fixture bolts and hardware matching fixture, 1 1/4 inch diameter steel uprights welded to 4 inch square steel floor anchor plates.

1) Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith Mfg.; Series 637 or comparable product, by one of the following:
   a) Josam
   b) Zurn
   c) Wade

2.2 URINAL FLUSHOMETER VALVES

A. Battery Powered Flushometer Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard urinal and flushometer system units as listed in Article 2.1, or comparable product by the following:

   a. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include sweat solder adapter, cast set screw escutcheon, casing tube, integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Style: Exposed.
8. Actuator: Solenoid complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
9. Trip Mechanism: Hard-wired electronic sensor complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
10. Consumption: 1.0 gal. per flush.
11. Minimum Inlet: NPS 3/4.
12. Minimum Outlet: NPS 3/4.
13. Power Supply: From concealed enclosure, 120 VAC to 6 VDC, per manufacturer's instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.

B. Examine walls and floors for suitable conditions where urinals will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Beginning installation constitutes Contractor's acceptance of substrates and conditions.

3.2 INSTALLATION

A. Urinal Installation:

1. Install urinals level and plumb according to roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
3. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for wall-hung urinals.
2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
3. Use carriers without waste fitting for urinals with tubular waste piping.
4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

C. Flushometer-Valve Installation:

1. Install flushometer-valve water-supply fitting on each supply to each urinal.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Power enclosures to be provided by the Electrical Contractor per the flushometer manufacturer's instructions.

D. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
2. Install escutcheon so set screw is facing floor.
3. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

E. Joint Sealing:

1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to urinal color.
3. Comply with sealant requirements specified in "Joint Sealants."

3.3 CONNECTIONS

A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Coordinate electronic-sensor power supply enclosures with Electrical and General Contractors.

3.5 CLEANING AND PROTECTION

A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed urinals and fittings.

END OF SECTION 22 42 13.16

SECTION 22 42 16.13 - COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Lavatories.
2. Faucets.
3. Supplies.
4. Drains.
5. Traps.
6. Supports.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals and informational submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1. Lavatory: Self-rimming, counter mounted, accessible.
2. Lavatory: Vitreous china, wall mounted, accessible with back.
3. Lavatory Faucets: Automatic-type, hard-wired, electronic-sensor-operated, mixing, solid-brass valve.
4. Supply fittings.
5. Straight tailpiece drains.
6. Offset tailpiece drains.
7. Standard traps.

B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

a. Servicing and adjustments of automatic faucets.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

A. Lavatory: Self-rimming, counter-mounted, accessible.

1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard; Rondalyn Model No. 0491.019 or comparable product by one of the following:

a. Kohler Co.
b. Sloan Valve Company.
c. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: Self-rimming for above-counter mounting.
c. Nominal Size: Round, 19 1/8”; Bowl, 15” W x 12 1/8” D x 5 3/4” Deep.
d. Faucet-Hole Punching: Three (3); Two (2) 1 1/4” dia. water at 4 3/8” center set, One (1) 1” dia. Centered, for power cable.
e. Faucet-Hole Location: Top.
f. Color: White.

g. Mounting Material: Sealant.

3. Faucet: Refer to Plumbing Fixture Schedule on Drawings.
4. Supplies: Refer to “Supply Fittings” Article.
5. Drain: Refer to Plumbing Fixture Schedule on Drawings.
6. Trap: Refer to Plumbing Fixture Schedule on Drawings.
7. Trap: Refer to Plumbing Fixture Schedule on Drawings.

2.2 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory: Vitreous china, wall mounted, accessible with back.

1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard America; Lucerene No. 0355.012 or product by one of the following:

   a. Kohler Co.
   b. Sloan Valve Company.
   c. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Fixture:

   a. Standard: ASME A112.19.2/CSA B45.1.
   b. Type: For wall hanging.
   c. Nominal Size: Rectangular, 20 by 18 inches.
   d. Faucet-Hole Punching: Three (3); Two (2) 1 1/4” dia. Inater at 4 3/8” center set, One (1) 1” dia. Centered, for power cable.
   e. Faucet-Hole Location: Top.
   f. Color: White.
   g. Mounting Material: Chair carrier.

3. Faucet: Refer to Plumbing Fixture Schedule on Drawings.
4. Supplies: Refer to “Supply Fittings” Article.
5. Drain: Refer to Plumbing Fixture Schedule on Drawings.
6. Trap: Refer to Plumbing Fixture Schedule on Drawings.
7. Support:

   a. Standard: ASME A112.6.1M.
   b. Description: Type II, concealed-arm lavatory carrier with 1-inch x 3-inch rectangular steel uprights and 4-inch square steel floor anchor plate.

2.3 SOLID-BRASS, AUTOMATICALLY OPERATED LAVATORY FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Lavatory Faucets: Automatic-type, battery powered, electronic-sensor-operated, mixing, solid-brass valve.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

   a. American Standard America.
   b. Kohler Co.
   c. Moen Incorporated.
   d. Sloan Valve Company.
   e. Speakman Company.
   f. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. General: Coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
5. Body Type: Three (3) hole, refer to lavatory fixture for description.
6. Body Material: Commercial, solid brass.
7. Finish: Polished chrome plate.
8. Maximum Flow Rate: 2.2 gpm.
9. Mounting Type: Deck, concealed.
10. Spout: Rigid type.
11. Spout Outlet: Aerator.
12. Drain: Not part of faucet.

2.4 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1. Basis-of-Design Product: Subject to compliance with requirements, provide McGuire Manufacturing, Inc.; No. H2165 or product by one of the following:

1. American Standard America.
2. Zurn Industries, LLC; Commercial Brass and Fixtures.

C.

D. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass escutcheon with set screw.

E. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

F. Operation: Handwheel.

G. Risers:
   1. NPS 1/2.
   2. Chrome-plated, rigid-copper-pipe and brass straight or offset tailpieces riser.

2.5 DRAINS

A. Straight Tailpiece:

   1. Basis-of-Design Product: Subject to compliance with requirements, provide McGuire Manufacturing, Inc.; No. 155-A or product by one of the following:
      a. American Standard America.
      b. Zurn Industries, LLC; Commercial Brass and Fixtures.

B. Offset Tailpiece:

   1. Basis-of-Design Product: Subject to compliance with requirements, provide McGuire Manufacturing, Inc.; No. 155-WC or product by one of the following:

      a. American Standard America
      b. Zurn Industries, LLC; Commercial Brass and Fixtures.

C. Standard: ASME A112.18.2/CSA B125.2.

D. Drain: Grid type with NPS 1-1/4 tailpiece.

E. Material: Seamless, chrome plated cast brass, brass locknut, heavy rubber basin washer and fiber friction washer.

2.6 TRAPS:

A. Standard Trap:

   1. Basis-of-Design Product: Subject to compliance with requirements, provide McGuire Manufacturing, Inc.; No. 8902-F or product by one of the following:

      a. American Standard America.
      b. Zurn Industries, LLC; Commercial Brass and Fixtures.

   2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow, 17 gauge brass tube to wall with cleanout plug. Include chrome-plated brass escutcheon with set screw.

B. Standard: ASME A112.18.2/CSA B125.2.

C. Size: NPS 1-1/2 by NPS 1-1/4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

B. Examine counters and walls for suitable conditions where lavatories will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 INSTALLATION

A. Install lavatories level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in “Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

C. Coordinate electronic-sensor power supply receptacles with Electrical and General Contractors.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

END OF SECTION 22 42 16.13

SECTION 22 42 16.16 - COMMERCIAL SINKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Service basins.
2. Utility sinks.
3. Sink faucets.
4. Laminar-flow, faucet-spout outlets.
5. Supply fittings.
6. Waste fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

a. Mop receptor and trim
b. Utility Sinks: Standard stainless steel, counter mounted, accessible.
c. Mop Receptor Faucets: Manual type, single-control mixing valve.
d. Sink Faucets: Manual type, single-control mixing valve with swing spout.
e. Supply Fittings.
f. Drain Fitting.
g. Utility Sink Traps.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sinks to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 SERVICE BASINS

A. Mop Receptor: Plastic, floor mounted.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Crane Plumbing, L.L.C.; Fiat Model No. TSBC1611, 32” x 32” x 12” nominal or product by one of the following:

a. Ferguson Enterprises, Inc.; ProFlo Brand.
b. Florestone Products Co., Inc.
c. Mustee, E. L., & Sons, Inc.
d. Swan Corporation (The).
e. Zurn Industries, LLC; Light Commercial Specialty Plumbing Products.

2. Fixture:

a. Standard: IAPMO/ANSI Z124.6.
b. Material: Cast polymer.
c. Nominal Size: 32” x 32” x 12” w/6” drop front.
d. Tiling Flange: On two sides.
e. Rim Guard: On front top surfaces.
f. Color: Standard.
g. Drain: Grid with NPS 3 outlet.

3. Mounting: On floor and flush to wall.
4. Faucet: Refer to "Sink Faucets" Article.

2.2 UTILITY SINKS

A. Utility Sinks: Standard stainless steel, counter mounted.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay Manufacturing Co; Model No. LR3722 or product by one of the following:

a. Advance Tabco.
b. Eagle Group; Foodservice Equipment Division.
c. Griffin Products, Inc.
d. Just Manufacturing.

2. Fixture:

a. Standard: ASME A112.19.3/CSA B45.4.
b. Type: Ledge back.
c. Number of Compartments: One.
d. Overall Dimensions: 37 x 22 x 7 5/8 inches deep.
e. Metal Thickness: 0.050 inch.
f. Material: Type 304 stainless steel with fully undercoated underside.
g. Compartment:

1) Dimensions: 16 x 16 x 7.625 inches deep.
2) Drain: 3.5 inch opening.
3) Drain Location: Centered, near back of compartment.

3. Faucet(s): Refer to Plumbing Fixture Schedule on Drawings.

a. Number Required: One.
b. Mounting: On ledge.

4. Supply Fittings: McGuire Co., Model No. H2165-F, Hand wheel

5. Waste Fittings: McGuire Co., Model No. 8089-F, 1 1/2” x 1 1/2” I.P.S. Outlet
a. Basket Strainer: McGuire Co. Model No. 151A, stainless steel, 1 1/2” x 4” 20-gauge tailpiece.

6. Mounting: On counter with sealant.

2.3 SINK FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.

B. Mop Receptor Faucets: Manual type, single-control mixing valve.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Speakman Company: Model No. SC-5811 or product by one of the following:

a. Chicago Faucets.
b. Delta Faucet Company.
c. Moen Incorporated.
d. T & S Brass and Bronze Works, Inc.
e. Zurn Plumbing Products Group.

2. Standard: CSA/ASSE-1001.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
4. Body Type: Widespread.
5. Body Material: Commercial, solid brass.
6. Finish: Polished chrome plate.
7. Maximum Flow Rate: 10 gpm hot- and cold-water full open at 40 psi.
8. Handle(s): Cross, four arm.
9. Mounting Type: Back/wall, exposed.
10. Spout Type: Rigid, solid brass with wall brace.
11. Vacuum Breaker: Required for hose outlet.
12. Spout Outlet: Hose thread according to ASME B1.20.7.
13. Integral Stops: Required.

C. Sink Faucets: Manual type, single-control mixing valve with swing spout.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Speakman Co.; Model No. S-3661-HS-LF or product by one of the following:

   a. Delta Faucet Company.
   b. Elkay Manufacturing Co.
   c. Moen Incorporated.
   d. T & S Brass and Bronze Works, Inc.
   e. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
4. Body Type: Faucet and spout.
5. Body Material: General-duty, solid brass.
6. Finish: Chrome plated.
7. Maximum Flow Rate: 2.2 gpm.
8. Handle: Single lever.
9. Mounting Type: Deck, exposed.
10. Spout Type: Swing, shaped tube.
11. Spout Outlet: Laminar flow control, vandal-resistant, 2.2 gpm.
12. Hose & Spray Attachment: Required.

2.4 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Basis-of-Design Product: Subject to compliance with requirements, provide McGuire Manufacturing, Inc. No. H2165-F or product by one of the following:

1. American Standard America

2. Zurn Industries, LLC; Commercial Brass and Fixtures.

C. Standard: ASME A112.18.1/CSA B125.1.

D. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass escutcheon with set screw.

E. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

F. Operation: Wheel handle.

G. Risers:

1. NPS 1/2.
2. Chrome-plated, soft-copper flexible tube.

2.5 DRAINS

A. Drain Fitting:

1. Basis-of-Design Product: Subject to compliance with requirements, provide McGuire Model No. 151A or product by one of the following:

a. Elkay Manufacturing Co.
b. Just Manufacturing.
c. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Standard: ASME A112.18.2/CSA B125.2.
3. Drain: Conical basket strainer with removable stopper and chrome plated brass NPS 1-1/4 x 4 inch tailpiece.
4. Material: Stainless steel body with polished finish.

2.6 TRAPS:

A. Utility Sink Traps:

1. Basis-of-Design Product: Subject to compliance with requirements, provide McGuire Manufacturing, Inc. No. 8089 or comparable product by one of the following:

a. American Standard America.
b. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow, 17 gauge brass tube to wall with cleanout plug. Include chrome-plated brass escutcheon with set screw.
3. Standard: ASME A112.18.2/CSA B125.2.

4. Size: NPS 1-1/2 by NPS 1-1/2.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sinks level and plumb according to roughing-in drawings.

B. Set floor-mounted sinks in leveling bed of cement grout.

C. Install water-supply piping with stop on each supply to each sink faucet.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 22 05 23 "General-Duty Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

E. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in "Joint Sealants."

3.3 CONNECTIONS

A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Architect.

END OF SECTION 22 42 16.16

SECTION 230000 - GENERAL REQUIREMENTS MECHANICAL AND ELECTRICAL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Work under this Section is subject to the requirements of the Contract Documents, including the Drawings, General and Supplementary Conditions, and Division 1 of the Specifications.

B. This section is hereby made a part of all other sections of Division 21, 22, 23 & 26 as fully as if repeated in each therein.

1.2 GENERAL PROVISIONS

A. The conditions of Division 1 GENERAL REQUIREMENTS apply to each and every Contract and Contractor or other person or persons supplying any material or labor entering this building, either directly or indirectly.

B. Mechanical and Electrical Contractors are bound by provisions of Conditions as described above.

C. Five (5) Sub-Contractors will be covered by these General Requirements. They are:

1. Heating, Ventilating and Air Conditioning.
2. Plumbing and Drainage.
3. Fire Suppression.
4. Electrical.
5. ATC (Direct Digital Controls).

D. For simplicity, these Sub-Contracts and Sub-Contractors will be referred to further herein as the HVAC, Plumbing, DDC Controls and Electrical Contracts or Contractors.

E. The term "Mechanical Contractor" shall mean the HVAC, Plumbing, Fire Suppression, and DDC Controls Contractors.

1.3 DESCRIPTION

A. The Drawings and Specifications shall be understood to cover systems of Plumbing, Fire Protection, Heating, Ventilation and Air Conditioning, Temperature Control, and Insulation and Pipe Covering as shown on the drawings and as specified. The drawings and specifications are to be taken together. Work specified and not shown, or work shown and not specified, shall be as binding as though required by both, the drawings and specifications.

B. Minor items and accessories or devices reasonably inferable as necessary to the complete and proper operation of any system shall be provided for such systems, whether or not they are specifically called for by the specifications or the drawings.

1.4 DEFINITIONS

A. Exposed: Open to view inside the building.

B. Concealed: Any piping, ductwork or equipment not considered exposed to view. For example, spaces between ceiling and floor construction above; between double walls; furred-in areas; pipe and duct shafts, etc.

C. Conditioned: Forced supply or return air, which has been heated or cooled.

D. HVAC: Heating, Ventilating, and Air-Conditioning.

E. Fixture Runout: Branch pipe connection to a terminal unit.

F. Mechanical Equipment Room: Any room or confined space, such as a penthouse, pump room, fan room, or service room, where mechanical equipment is located.

G. “Where exposed to people’s contact” (Not including maintenance personnel): Being capable of being reached without the use of a ladder.

H. Exposed: In plain view of the end-user and occupants of any space other than mechanical or service spaces.

1.5 DRAWINGS AND SPECIFICATIONS

A. It is the intent of the specifications and drawings to include under each item all materials, apparatus and labor necessary to properly install, equip, adjust and put into perfect operation the respective portions of the installations specified and to so interconnect the various items or sections of the work as to form a complete and properly operating whole.

B. Any apparatus, machinery or small items not mentioned in detail which may be found necessary to complete or perfect any portion of the installation in a substantial manner and in compliance with the requirements stated, implied or intended shall be furnished without extra cost to the Owner. This shall include all materials, devices or methods peculiar to the machinery, apparatus or systems furnished and installed by the HVAC, Plumbing, Fire Protection, DDC Controls and Electrical Contractors.

C. In referring to drawings, figured dimensions take precedence over scale measurements. Discrepancies must be referred to the Architect for decision. Each Contractor shall certify and verify all dimensions before ordering material or commencing work.

D. Any work called for in the specifications, but not mentioned or shown on the drawings, or called for on the drawings, but not mentioned in the specifications, shall be furnished as though called for in both.

E. When any device or part of equipment is herein referred to in the singular number, such as "the pump" such reference shall be deemed to apply to as many such devices as required to complete the installation.

F. The term "Provide" shall mean "Furnish and Install". Neither term will be used generally in these specifications, but will be assumed. The term "Furnish" shall mean to obtain and deliver on the job for installation by other trades.

G. The Drawings are essentially diagrammatic in nature and show general arrangement of the equipment, piping, ductwork, accessories, etc. Because of the small scale of the Drawings, it is not possible to show each offsets, fittings, and accessories, which may be required. Carefully investigate the structural conditions, Architectural Drawings, Equipment Drawings, and the finished conditions of the work and arrange such work accordingly, furnish any fittings, pipe accessories that may be required to meet such conditions.

H. Any changes from the plans necessary to make the work conform to building as constructed and to fit work of other trades, or to conform to rules of the governing authorities and regulations, shall be met by the Contractor without extra cost to the Owner.

I. The layout of the piping, ductwork, equipment, etc., as shown on the Drawings shall be checked and exact locations shall be determined by the dimensions of equipment approved and Contractor shall obtain the Architect's approval for any revised layout before the apparatus is installed. The Contractor shall consult the Architectural, Structural, and Equipment Drawings for the dimensions, locations of partitions, locations and sizes of structural supports, foundations, to coordinate installation and penetrations, etc.

J. Contractor shall also refer to the Architectural Plans for details and large scale Drawings and to approved Shop Drawing of equipment furnished under other Contracts or Sections of the Specifications for exact location of service connections. The equipment Shop Drawings will be furnished to the Contractor before roughing in. Contractor shall not install any piping or ductwork for said equipment until they have received approved Coordination Drawings for same.

1.6 LAWS, ORDINANCES, REGULATIONS AND PERMITS

A. The entire HVAC, Plumbing, DDC Controls, Fire Protection, and Electrical Systems in all and or part shall conform to all pertinent laws, ordinances and regulations of all bodies having jurisdiction, notwithstanding anything in these drawings or specifications to the contrary.

B. The work shall be installed in conformity with the City, State and Federal, or Board of Underwriters' laws, regulations, rules, or ordinances in effect and governing same, such rules and regulations and local ordinances to be considered part of these Specifications. Contractor shall be held strictly responsible for any violation of same and shall change their work to conform without additional cost to Owner.

C. Each Contractor shall pay all fees and obtain and pay for all permits and inspections required by any authority having jurisdiction in connection with their work.

D. Electrical work shall comply with the requirements of the National Electrical Code, NFPA and other boards and departments having local jurisdiction. Electrical Contractor shall obtain and pay for Certifications of Inspection by an authorized Electrical

Inspection Agency and by local, municipal and state approving agencies. The materials, in general, shall be Underwriters' Laboratories listed and shall bear UL label.

E. Fire Protection Contractor to complete a "Material & Test Certificate" for above ground piping and/or for underground piping upon completion of work.

F. Fire Protection Contractor should notify Fire Marshal upon completion of the system, giving the Fire Marshal a minimum of five (5) day notice.

1.7 EXISTING UTILITIES

A. Location of utilities as shown on the drawings has been determined from the best available information and is given for the convenience of the Contractor; however, Owner does not assume responsibility in the event that during construction, utilities other than those shown may be encountered, and that the actual location of those which are shown may be different from the location as shown on the plans.

B. The Contractor shall be responsible for any interference with or damage to any existing utilities, and shall repair or replace same with the least possible delay.

C. The Contractor shall notify Architect of any broken or open pipes discovered during construction.

1.8 CONNECTIONS TO UTILITIES

A. Apply for and obtain services from utility companies and municipalities. All charges for which utility companies and municipalities must be reimbursed shall be paid for by the respective Contractor at no additional cost to the Owner.

1.9 TESTS

A. The following requirements are supplementary to tests specified for individual equipment or systems in Mechanical and Electrical work sections.

1. Give written notice of date of test in ample time to all concerned.

B. Concealed or insulated work shall remain uncovered until all required tests have been completed; but if construction schedule requires, arrange for prior tests on parts of systems as approved.

C. As soon as conditions permit, conduct preliminary tests of equipment to ascertain compliance with specified requirements. Make needed changes, adjustments and/or replacements as preliminary tests may indicate, prior to acceptance tests.

D. Conduct pressure, performance and operating tests as specified or required for each system or equipment unit in the presence of the Architect, Engineer or Owner as well as a representative of agencies having jurisdiction.

E. Obtain Certificates of Approval and/or Acceptance as specified or required in compliance with regulations of agencies having jurisdiction. Work shall not be deemed complete until such Certificates have been delivered to the Architect.

F. Testing shall prove conclusively that Mechanical and Electrical systems operate properly, efficiently and quietly in accordance with intent of drawings and specifications.

1.10 CONTINUITY OF SERVICES (SHUTDOWN AND NOTIFICATIONS)

A. It is imperative that service interruptions on the various existing utilities be held to an absolute minimum. Wherever possible, the Contractor shall provide suitable temporary services or connections, where continuity of service for essential systems can be maintained by this means. It will be the Owner's final prerogative to decide which systems are to be considered as essential, and to establish the maximum allowable shutdown time, if any, for each system.

B. Generally, no action shall be taken by the Mechanical and Electrical Contractors that will interrupt any of the existing building services for this building or any other building until previously arranged with the Architect and Owner or their authorized representative.

C. The Owner will require not less than 72 hours advance notice, in writing, that an interruption of service in any system is desired. Such notice shall identify the system or systems involved, and shall be submitted in duplicate, one (1) copy of which will be signed and returned by the Owner's authorized representative stating whether the requested shutdown will be permitted or not.

D. Should any service be interrupted by these Contractors, the Contractor causing such interruption shall provide immediately all labor, including overtime if necessary, and all material and equipment necessary for restoration of such service.

1.11 ENTRANCE OF EQUIPMENT

A. Each Contractor shall perform all necessary rigging required for completion of work under their contract.

B. Contractor shall be responsible to repair all damage as a result of rigging and/or bringing equipment into the building. All damaged items shall be restored back to their original condition at no additional cost to the Owner.

1.12 VISIT TO SITE

A. Due to the nature of the work involved under this contract, all bidders are required to thoroughly examine the site.

B. Bidding Contractors shall thoroughly review Contract Documents prior to visiting the site, take Contract Documents to site and thoroughly explore to any extent necessary, the existing conditions as relating to fulfilling the requirements of this Contract.

C. If discrepancies are noted between requirements of Contract Documents and existing conditions, Contractor shall so indicate to the Architect during bidding period and receive clarification before bidding. Failure to comply with this requirement will result in Architect’s interpretation during the construction period and the Architect’s decision will be final and binding as the sole interpreter of the contract requirements.

D. Extras will not be considered for any work relating to connections with existing systems or adaptability of new systems to existing structures.

E. Submission of proposals shall be considered evidence that Contractors have complied with the requirements of this Article.

1.13 LINES AND LEVELS

A. At the job site, the Contractor shall layout and establish the lines and levels necessary for this work by using Bench Marks.

1.14 OVERTIME WORK

A. It is contemplated that work included be done during regular working hours on a "straight time" basis.

B. Where a shutdown of essential utilities is required for final connections or "cross overs", the Owner and Architect shall be notified well in advance and approval obtained before proceeding with the work. The period of interruption of services shall be held to the minimum required to complete the work. If overtime work is required, this overtime shall be included as a part of the base bid.

1.15 INSTRUCTING OWNER'S PERSONNEL

A. After all tests and adjustments have been made, each Contractor shall fully instruct the representatives of the Owner in all details of operation of the equipment installed under their contract.

B. Each Contractor shall operate their equipment for sufficient length of time to satisfy the Architect that requirements of the Contract Documents have been fulfilled.

C. All training will be videotaped by the Contractor. Provide three (3) copies to the Maintenance Superintendent.

D. Operation & Maintenance Manuals for all Equipment and Systems must be submitted before any Instruction to Owner’s Personnel are scheduled.

1.16 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Each Contractor shall provide three (3) copies of printed instructions to the Architect upon completion of installation. Instructions shall be bound in separate, hardback, 3-ring or 3 D-ring loose leaf binders.

B. Instruction books shall be prepared by sections and contain detailed start-up, operating and maintenance instructions for all components of all systems, including wiring, and piping diagrams necessary for clarity. The cover of each binder shall be identified with the name of the project and the words "Operating and Maintenance Instructions".

C. Each section shall have labeled tabs and be clearly marked with equipment or system name and contain detailed parts list data, ordering information and the name, address and telephone number of the closest supply source.

D. All instructional data shall be neatly and completely prepared to the satisfaction of the Architect/Engineer.

E. Operation & Maintenance Manuals for all Equipment and Systems must be submitted before any Instruction to Owner's Personnel are scheduled.

1.17 GUARANTEE

A. All material, equipment and workmanship provided by each Contractor shall be in first class operating condition in every respect at time of acceptance by Owner. Acceptance by the Owner shall be by letter to this effect written to each Contractor.

B. Each Contractor shall unconditionally guarantee in writing all materials, equipment and workmanship for a period of one (1) year from date of acceptance by Owner unless a longer period is stipulated under specified headings. During the guarantee period each Contractor shall repair or replace, at their own expense, any materials, equipment or workmanship in which defects may develop and they shall also provide free service for all equipment and systems involved in their contract during this guarantee period.

C. Guarantee shall also include restoration to its original condition of all adjacent work that must be disturbed in fulfilling this guarantee.

D. All such repairs and/or replacements shall be made without delay and at the convenience of the Owner.

E. Repairs or replacements shall bear an additional twelve (12) months guarantee from the time repair or replacement is complete. This requirement shall be binding, even though it will exceed product guarantees normally furnished by some manufacturers.

F. Guarantees furnished by Subcontractors and/or Equipment Manufacturers shall be counter-signed by the related Contractor for joint and/or individual responsibility for subject item.

G. Manufacturer's equipment guarantees or warranties extending beyond the guarantee period described above shall be transferred to the Owner along with the contractor's guarantees.

H. Note that guarantees shall run from the date of final payment for the complete project, not from the date of installation of, or payment for an item or device.

1.18 MINOR DEVIATIONS

A. The dimensions of equipment hereinafter specified or indicated on the Drawings are intended to establish the outlines and characteristics of such equipment in general. Minor deviations in dimensions will be permitted to allow the manufacturers specified to bid on their nearest stock equipment, provided the specified ratings are met or exceeded.

B. Where manufacturers' catalog numbers or types are mentioned in the Specifications or indicated on the Drawings, they are intended to be used as a guide only and shall not be interpreted as taking precedence over the basic rating and duty specified. In all cases,

manufacturers shall verify the duty specified with particular characteristics of the equipment they intend to offer for approval and shall also pay the additional charges as may be required under other Divisions.

1.19 SHOP DRAWINGS

A. Submit twelve (12) copies of shop drawings for all material and equipment as noted in Manufacturer's and Sub-Contractors List, except where indicated otherwise further herein.

B. Prior to submission of shop drawings, the Contractor shall notify the Architect of any site conditions differing from those indicated or specified.

C. Prepare shop drawings by careful reference to drawings and specifications.

D. Identify each shop drawing by Job Name and reference to applicable Specification Article number.

E. Shop drawing data for all equipment shall include, but not be limited to, the following:

1. Manufacturers' catalog designation, photographs and specifications.
2. Full electrical data, including specifically, electrical characteristics.
3. Dimensions, capacities, ratings, material and finish.
4. Such other detailed information as required for proper evaluation.

F. Review Time:

1. Allow two (2) weeks for the Engineer's processing of each submittal, exclusive of Owner’s, Architect’s or others in the processing chain. Allow a longer time period where processing must be delayed for coordination with subsequent submittals.

G. Submission of shop drawings for electric motor starters shall include a tabulation listing:

1. The equipment the starter is intended to control.
2. Horsepower.
3. Voltage.
4. Phase.
5. Full load amperes.
6. The manufacturer's number or type.
7. Overload heater numbers and amperage.
8. Quantity of auxiliary contacts.
9. Pushbutton arrangement.
10. Pilot light arrangement if applicable.

H. Each Contractor shall examine all shop drawings before submission for review. Each Contractor shall then forward all shop drawings with their initialed acceptance stamp and by so doing the Contractor thereby represents that they have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers, and similar data, have notified the Architect/Engineer of site conditions varying from those indicated or specified, and that they have checked and coordinated each item with

other applicable accepted shop drawings and the contract requirements. Shop drawings and catalog data submitted without the Contractor's stamp of acceptance will be returned to the Contractor without review.

I. Shop drawings smaller than 8-1/2 x 11 shall be secured to letter size paper of this size.

J. Material and equipment installed or used without shop drawing review are subject to rejection by the Engineer.

K. The HVAC Contractor shall prepare 1/4-inch minimum scale sheet metal shop drawings at the earliest practical time and coordinate these drawings with the other contractors prior to erection of the sheet metal work in order to effect timely resolution of all conflicts with the work of other contractors.

L. Corrections or comments made on shop drawings during review by the Engineer does not relieve the Contractor from compliance with requirements of the drawings and specifications. Such review shall be only for general conformance with the design concept and general compliance with the information given in the Contract Documents. It shall not include review of quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with the work of other trades, or construction safety precautions, all of which are the sole responsibility of the Contractor. Review of a specific item shall not indicate acceptance of an assembly of which the item is a component. The Engineer shall not be responsible for any deviations from the Contract Documents not clearly noted by the Contractor, nor shall the Engineer review partial submissions or those for which submissions for correlated items have not been received. The Contractor is responsible for: confirming and correlating all quantities, clearance and dimensions, selecting fabrication processes and techniques of construction, coordinating work with that of all other trades, and performing their work in a safe and satisfactory manner.

M. Furnish two (2) print sets of the pipe layouts, duct layouts and equipment drawings on ¼” = 1’-0” scale plans using AutoCAD Release 2006/2010. The drawings shall show the coordination between new work and existing system conditions; include a symbol list, title block information, drawing titles, key plan, north arrow, room names and numbers, match lines; pipe heights; details of congested areas; and a typical elevation showing discipline coordination. The sheet size for floor plans and associated details shall match the Design Drawing sheet size. The ductwork layout shall be shown in double line. The drawing’s layering system shall comply with the Owner’s AutoCAD Standards Manual.

N. Any shop drawing or submittal requiring more than two (2) resubmissions for approval, the Contractor shall pay the Engineer $250.00 per resubmitted item, until approval is granted. Payment must be received prior to the Engineer’s review.

O. Electronic drawing files in AutoCAD, Release 2010 will be available to the Sub-contractors through the General Contractor. If electronic drawing files are requested, the Engineer shall provide compact diskettes (CDs) to the Contractor containing the mechanical, plumbing, gas, fire protection, and electrical floor plans.

1.20 AS-BUILT DRAWINGS

A. During the course of the work, maintain a record set of drawings on which shall be marked the actual physical location of all piping, valves, equipment, conduit, outlets, access panels, controls, actuators, etc.

B. Include all Addendum, Change Orders and construction field directives (responses to RFI's) on the As-Built Drawings.

C. At project completion, obtain a clean set of prints and an AutoCAD 2006/2010 CD from the Engineer, and make a set of reproducibles. Neatly transfer all the recorded as-built information on both the reproducibles and AutoCAD 2006/2010 CD.

D. Provide two (2) prints of these reproducibles, along with the reproducibles themselves and CAD CD, to the Engineer. In addition, attach one (1) complete set of prints to each of the OPERATING AND MAINTENANCE INSTRUCTIONS specified previously herein.

1.21 PUNCH LIST CLOSE-OUT

A. Each Contractor shall carefully read and review each punch list item.

B. Contractors shall review the contract documents and job correspondence minutes relating to punch listed items to assure thorough understanding thereof within three (3) working days after receipt of the punch list.

C. It is the responsibility of the Contractor to contact the author of the punch list to resolve any items in question, including factual inclusion of the punch listed items, as part of the work covered by the contract documents as basic services.

D. In the absence of such contact, the Contractor agrees to comply with all items in the punch list.

E. Upon resolution of the final punch list items, reduce the action taken to writing on the Contractor's company letterhead, and state, for the record, by reference to each punch list item, thereby absolving the Architect/Engineer of the responsibility of repeatedly visiting the site to verify completion of final punch list items. The Contractor's letter is to be termed "Final Punch List Resolution Letter."

F. Contractor must clearly state where exceptions are taken.

G. Approval of final payments for work done by the Contractor will be granted upon receipt and acceptance of the "Final Resolution Letter."

1.22 TEMPORARY FACILITIES, UTILITIES AND HEATING

A. Refer to Section TEMPORARY FACILITIES AND CONTROLS in Division 1 of these specifications.

1.23 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

A. Summary of Work
B. Project Meetings
C. Construction Schedules
D. Temporary Facilities
E. Project Closeout
F. Project Record Documents

PART 2 – MATERIALS

2.1 MANUFACTURER'S AND SUB-CONTRACTORS LIST

A. Before ordering any material or equipment unit, and not later than twenty (20) working days after signing of contracts each Contractor shall submit a list of Manufacturers, Sub-Contractors and Suppliers showing make, type, manufacturers name and trade designation of all materials, and equipment, proposed for use under this contract. List shall be prepared by reference to specifications.

B. The list, when accepted, shall be supplementary to specifications, and no variations therefrom will be permitted except with the approval of the Architect/Engineer.

C. No shop drawings will be processed until the Contractor has satisfactorily completed the requirements of this Article.

2.2 MATERIALS AND EQUIPMENT

A. All materials and equipment shall be new, unless noted otherwise, and shall conform to the grade, quality and standards specified herein.

B. All equipment offered under these specifications shall be limited to products regularly produced and recommended for service ratings in accordance with engineering data or other comprehensive literature made available to the public and in effect at the time of opening of bids.

C. Items such as valves, motors, starting equipment, vibration isolating devices, lamps, and all other equipment and material, where applicable and practicable, shall each be of one manufacturer.

D. Equipment shall be installed in strict accordance with manufacturer's instructions for type and capacity of each piece of equipment used. Contractors shall obtain these instructions which will be considered part of these specifications. Type, capacity and application of equipment shall be suitable and shall operate satisfactorily for the purpose intended in the HVAC, Plumbing and Electrical Systems.

2.3 EQUIPMENT VARIATIONS

A. The materials and products mentioned in these specifications are given to establish a standard of quality, design and performance. The phrases "equivalent acceptable", "or equal", "equal to", and “approved substitute” shall be used to indicate that other similar

products may be used provided such substitutes are accepted by the Architect as meeting all standards necessary to perform the function intended. Where three (3) or more manufacturers are mentioned for an item, selection shall be made from among those manufacturers. Specific products listed without reference to equals or substitutions shall be provided as specified, unless a written request for substitution is submitted to the Architect for approval ten (10) days prior to the date for receipt of bids. Such request shall include a complete description of the proposed substitute, along with sufficient documentation and other information necessary for a complete evaluation of the proposed substitution. If approved, substitute product will be listed in an addendum so that all bidders are alerted to it.

B. The Contract Documents have been prepared to provide for the incorporation of at least one of the specified items or assemblies of every category of materials, products or pieces of equipment. In the event that the incorporation into the work of an approved substituted item or assembly will require revisions or additions to the contractual requirements of either the contractor proposing the substitution or any other contractor, the contractor proposing the substitution shall bear the cost of such revisions or additions to the work of all trades affected, and shall pay for all engineering or architectural services required at no change in the contract sum.

2.4 VIBRATION ELIMINATION

A. The Mechanical and Electrical Contractors shall provide vibration isolation support provisions for all moving or rotating equipment, machinery and transformers when such provisions are not furnished and/or integrally mounted by the equipment manufacturers. They shall be equal to Amber/Booth Company or Korfund Company, Inc., and installed in accordance with vibration isolation manufacturers' recommendations unless specified otherwise herein.

B. Provide all rotating or moving machinery or equipment suspended from building structure with approved resilient suspension mountings.

C. Provide the equivalent of Flexonics Corp. metallic vibration isolating connections between all pumps and connecting piping.

D. All electrical connections to moving or vibrating equipment, such as motors, generators, transformers, etc., shall be made by use of flexible metallic conduit.

E. No rigid pipes, ducts, conduit or other extended machine assemblies connected to vibration isolated equipment shall be tied in directly with the building construction. Such elements shall be connected to the equipment through flexible fittings, and be supported by isolating equipment as required.

F. All systems shall operate free from objectionable vibration and noise resulting therefrom, and each Contractor shall take all necessary steps required to achieve this result without additional cost to the Owner.

2.5 ACCESS DOORS AND PANELS

A. Each Mechanical and Electrical Contractor shall furnish and locate for installation under General Construction, all access doors and panels for concealed portions of Mechanical

and Electrical work requiring accessibility for operation and maintenance of their installed work.

B. Minimum door size of 24" x 18" unless shown, specified or approved otherwise.

C. Sixteen (16) gauge minimum doors with screw fasteners and painted finish. They shall be equal to Inryco/Milcor, Karp Associates as follows:

WALL OR CEILING SURFACES INRYCO/MILCOR, KARP

Drywall (ceiling)	DW	KSTDW
Drywall (wall)	DW	KDW
Hard Plaster & Ceramic Type	K	DSC-214PL
Unplastered Masonry & Concrete	M	DSC-214M
Acoustic Tile	AT	KST

D. Underwriters "B" label access doors where required for access to shafts, corridors, and where located in fire walls and partitions.

E. No access panels shall be installed without specific approval of the Architect as to location. The proposed location of panels of each Contractor shall be reviewed with the Architect by the General Contractor's Job Superintendent before installation of equipment or panels. Controversies must be resolved at no cost to the Owner.

2.6 ANCHOR BOLTS

A. Mechanical and Electrical Contractors shall provide and set in place at the time foundations, bases or curbs are poured or formed, all necessary anchor bolts as required for the various equipment specified herein. They shall be hook type anchor bolts of proper size and length to suit the apparatus. Set bolts in pipe sleeves of approximately twice the bolt diameter and of length equal to the embedded length of the bolt, with sleeves terminating flush with finished surfaces of foundations, bases or curbs.

B. When the equipment is set in its proper position and aligned with the anchor bolts, the space between the anchor bolts and the inside wall of the sleeves shall be completely filled with non-shrink cementitious grout equal to Crystex as manufactured by L & M Construction Chemicals, Inc., Master Builders or approved equal.

C. Each Contractor shall assume all responsibility for the location of all anchor bolts for the equipment furnished by them under these specifications, and must have a representative present at the time foundations, bases or curbs are poured or formed.

D. All anchor bolts shall be of sufficient strength to withstand any loading imposed by the attached materials or equipment.

2.7 SLEEVES

A. Each Contractor shall furnish and set all sleeves required for their work and be fully responsible for the final and permanent locations thereof.

B. Sleeves shall be provided in the following locations:

1. All pipes passing through all cast-in-place concrete construction and masonry walls.
2. All conduits passing through cast-in-place waterproof concrete construction and waterproof masonry walls.

C. Sleeves shall extend through construction and be finished flush with each surface except where noted otherwise. Each sleeve shall provide for a minimum ½" clearance around pipe, or its covering in the instance of pipe covered with insulation.

D. All sleeves in waterproof walls shall be fitted and sealed with positive hydrostatic "Link Seals" as manufactured by Thunderline Corporation. Sleeves shall be sized accordingly. Link Seals shall be placed around piping and/or conduit and inserted into the void between inner wall of sleeve and piping and/or conduit. Tighten link seals as required for watertight seal.

E. All sleeves shall be Schedule 40 steel pipe finished with smooth edges. Sleeves in waterproof walls shall be fabricated with minimum 1/4" thick rectangular steel plate placed around mid-point of sleeve, continuously welded to sleeve and then the entire/plate assembly placed into proper position prior to erection of walls. Otherwise sleeves shall be provided with a minimum of three (3) lugs for anchoring.

F. Voids between sleeves and piping or conduit, where located in fire partitions or masonry walls, shall be packed with mineral fiber rope, with fire-rate link seals or foamed with proper 3M fire-rate fitted foam.

G. All sleeves shall be set prior to or during erection of walls. Cutting or drilling of walls after erection will not be permitted.

H. If sleeves are omitted or located incorrectly the particular contractor who is at fault shall at their own expense, engage the trade which originally installed the work to cut and patch to the satisfaction of the Architect/Engineer.

I. Any pipe or conduit that must pass through pre-cast floors and will be exposed in finished areas that have floor drains including areas such as Janitors Closets, Toilet Rooms and the like shall be made watertight by use of "Link Seals" inserted into void between piping and/or conduit and openings thereof.

J. All openings for piping and conduit in existing masonry or concrete work shall be neatly coredrilled.

2.8 MANUFACTURER'S NAMEPLATES

A. Each major component of the equipment shall have the manufacturer's name, address, model number and rating on a plate securely affixed in a conspicuous place. The nameplate of a distributing agent is not acceptable. ASME Code ratings, or other data, which is die-stamped into the surface of the equipment, shall be in a visible location.

PART 3 – EXECUTION

3.1 METHOD OF PROCEDURE

A. The drawings accompanying these specifications are diagrammatic and intended to cover the approximate and relative locations of the HVAC, Plumbing, DDC Controls and Electrical Systems.

B. Installation, connection and interconnection of all components of these systems shall be complete and made in accordance with the manufacturer's instructions and best trade practices.

C. Each Contractor shall erect all parts of equipment to be furnished under their contract at such time and in such manner as not to delay or interfere with other Contractors on the work.

D. All piping, conduit and duct work shall be plugged as required during construction to prevent entering of dirt.

E. Before material is ordered or any work performed, each Contractor shall verify all measurements, including lines, grades, pipes, conduit and duct work elevations at the building and shall be responsible for the correctness thereof. No extra compensation will be allowed on account of differences between actual dimensions and measurements and those indicated in the Contract Documents. Any discrepancies discovered shall be submitted to the Architect for consideration before proceeding with the work.

F. Each Contractor shall lay out their work and be responsible for the establishment of heights, grades, etc., for all interior and exterior piping, drains, fixtures, conduit, duct work, etc., included in Contract Documents, in strict accordance with the intent expressed thereby; and all the physical conditions to be met at the building and finished grade, and shall be responsible for accuracy thereof. The establishment of the location of all work shall be performed in consideration of the finished work. In case of conflict, equipment and/or materials shall be relocated without cost to the Owner, as directed by the Architect/Engineer, regardless of which equipment was installed first.

G. Each Contractor shall cooperate with other Contractors for the proper securing and anchoring of all work included within these specifications. Extraordinary care shall be used in the erection and installation of all equipment and materials to avoid marring surfaces of the work of other Contractors, as each Contractor will be held financially responsible for all such injury caused by the lack of precaution and due to negligence on the part of their workers.

H. Do not run pipe or conduit for Mechanical and Electrical Systems in any concrete slab three inches (3") or less in thickness. Do not place any pipe or conduit in any slab where the outside diameter of the pipe or conduit is more than one-quarter the thickness of the slab.

I. All piping, duct work, conduit and other Mechanical and Electrical materials and equipment shown to be mounted below ceilings are to be kept as close to ceiling areas as possible unless otherwise noted.

J. Items such as valves, dampers, cleanouts, etc. that will be concealed in construction shall be installed and so arranged as to be fully accessible for adjustment, service and maintenance.

3.2 ERECTION AND WORKMANSHIP

A. Contractor shall adapt their work to job conditions and make such changes as required and permitted by the Architect/Engineer such as moving their work to clear beams, joists, light fixtures, etc., adjusting risers, avoiding interferences with windows and openings, etc., raising or lowering their work to permit the passing of ductwork or the work of other trades etc., as required or as job conditions dictate, without any additional cost to the Owner.

B. The workmanship shall be first class in every respect and shall be performed only by skilled mechanics, recognized as such in their respective trades.

3.3 PROTECTION

A. All piping, materials and accessories having finished polished chromium plated surfaces and machines with finished or unpainted surfaces of equipment furnished under these specifications shall be given a thick coat of a neutral protection grease and carefully covered with thick cloth or heavy building paper held securely in place to protect the finish against damage during the entire period of construction. Equipment shall also be protected by use of canvas tarps, vinyl sheeting or similar materials held securely in place.

B. All openings in pipes, fittings, duct work, conduit and all other materials shall be effectively sealed to exclude dirt, sand, and other foreign materials.

C. Exercise every precaution to exclude dust, dirt and all other foreign materials from switchgear rooms, transformers, and all mechanical equipment rooms during construction. Rooms and equipment contained therein shall be vacuum cleaned at regular intervals. All relays, meters and mechanical equipment contained with electrical components shall be protected with heavy paper held in place with approved mastic tape to exclude fine dust and particles. Sufficient electric heaters shall be installed and maintained in equipment rooms and transformer compartments to keep equipment dry during construction.

D. Any such fixtures, equipment or apparatus damaged prior to final acceptance of the work shall be restored to its original condition or replaced with a new one.

3.4 CUTTING AND PATCHING

A. New Construction:

1. Each Contractor shall provide and set all sleeves, inserts and other items required for the installation of their work and shall be responsible for their final and permanent locations.
2. Each of these Contractors shall confer with and give the General Prime Contractor complete information as to size of openings in all construction, so that such openings may be provided as the building progresses.
3. If openings are omitted or incorrect through failure of these Contractors to follow these instructions, the particular Contractor shall, at their own expense, engage the trade which originally installed the work to cut and patch to the satisfaction of the Architect.

B. Existing construction:

1. The General Contractor shall perform all cutting and patching required for the work of all trades.
2. Each of these Contractors shall confer with and give the General Contractor complete information as to size of openings in all construction, so that such openings may be provided as the building progresses.
3. If openings are omitted or incorrect through failure of the Contractor to follow these instructions, the particular Contractor shall, at their own expense, engage the trade which originally installed the work to cut and patch to the satisfaction of the Architect/Engineer.
4. All openings for pipe and conduit shall be neatly coredrilled.

3.5 CONCRETE AND MASONRY WORK

A. Mechanical and Electrical Contractors shall provide all cast-in-place concrete, pre-cast concrete and masonry work (brick and block) required for completion of their contracts.

B. The Architect shall review and approve materials used.

C. Unless shown or specified otherwise, all equipment foundations shall be six inches (6") minimum from floor, of sufficient mass, and secured to the floor.

3.6 SUPPORTS

A. Except where noted otherwise in the specifications and shown on drawings, each Contractor shall provide all materials, equipment supports, supplies and labor necessary as required to adequately support, brace and strengthen equipment and materials furnished as part of their contract.

B. The design, materials, fabrication and erection of structural steel supports shall conform to "Specification for Design, Fabrication and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction, "Code of Standard Practice for Steel Buildings and Bridges". Welding where required shall conform to "Code of Arc and Gas Welding in Building Construction" of the American Welding Society.

C. All steel supports shall be primed (primer plus two (2) coats) before and finish-painted after installation.

3.7 LINTELS

A. The General Contractor will furnish and install all lintels required for the installation and completion of all work of Mechanical and Electrical Contractors, provided that the General Contractor is advised in advance of such requirements.

B. Failure to give proper notice and/or to comply with the above requires the Sub-Contractor involved to be financially liable for all work and material necessary for the completion of required work.

3.8 ESCUTCHEONS

A. Except as noted otherwise, the Mechanical and Electrical Contractors shall provide heavy solid pattern, steel, cast iron or malleable iron escutcheons with set screws and prime coat of paint on all uninsulated piping and conduit exposed to view within structure where passing through floors, partitions, walls or ceilings. Escutcheons are not required in equipment rooms, boiler rooms or other unfinished areas.

B. For piping with sleeves extending above floor, provide escutcheons with deep recesses.

C. Provide solid pattern, smooth chrome plated cast brass escutcheons for all chrome plated pipe fixture connections.

D. Provide nickel plated cast iron escutcheons where pipes pass through toilet rooms, walls or ceilings.

E. Provide collars of angle fabrication for duct passing through floors, walls and ceilings in finished areas.

3.9 MACHINERY GUARDS

A. Provide approved expanded sheet steel metal guards over all belt drives, couplings and other moving equipment to protect personnel from injury.

3.10 FLASHING

A. Base and counter flashings shall be provided by the respective Contractor where work penetrates roof construction.

3.11 PAINTING AND FINISHING

A. All painting, generally, will be provided by the General Contractor, except where specifically noted otherwise in the Mechanical and Electrical Specifications.

B. Equipment and material furnished with factory enamel finish will not be painted unless finish has been damaged, in which case the equipment or material shall be refinished by the Contractor who furnished it, to the satisfaction of the Architect/Engineer.

C. Do not paint nameplates, labels, tags, stainless steel, or chromium-plated items such as valve stems, motor shafts, levers, handles, trim strips, etc.

D. Ductwork behind the grilles, registers, diffusers, etc. which is exposed to view through the units, shall be given one (1) coat of primer and a finish coat of flat black paint.

E. No work shall be allowed to develop rust during the course of the work. Work showing evidence of rust or other corrosion shall be immediately scraped clean and rust primed with an approved primer.

3.12 LUBRICATION

A. Each Contractor shall be responsible for the proper and necessary lubrication of any items of operating, rotating or moving equipment which they will furnish, install or which must operate as part of the systems on which they work.

B. When an item of operating equipment is furnished and installed by a Contractor, it will be their responsibility to accomplish the lubrication.

C. When an item of operating equipment is furnished by one Contractor and the installation by another, it shall be the responsibility of the Contractor furnishing the equipment to apply the lubricants.

D. All rotating or moving equipment shall be lubricated prior to energizing and operating the equipment. Should the Contractor responsible for the lubrication fail to apply lubricants prior to initial start-up and the equipment is damaged as a result of their negligence, that Contractor shall be required to provide all corrective action necessary including replacement, if required, for the proper operation of equipment.

E. Lubrication shall be accomplished in the manner prescribed or recommended by the manufacturer of the specific item. For motor driven equipment this precaution of lubrication will apply individually to the driver and the driven.

F. The lubricants shall be of the type, grade, specification and manufacture as prescribed or recommended by the manufacturer of the specific equipment item.

G. The Contractor who supplies any item of rotating equipment will have the responsibility of securing written instructions on the lubricating procedure and shall furnish not less than one year's supply of all necessary lubricants properly identified so they can be replaced.

H. Any moving or rotating equipment furnished by the Owner that is to be installed, reused and/or serviced shall also be lubricated. Except where noted otherwise in the Mechanical and Electrical specifications, the Contractor installing, reusing and or servicing all such equipment shall be responsible for the proper lubrication thereof including obtaining proper lubricating instructions from the various manufacturers involved, furnishing and applying the necessary lubricants and leaving the Owner with a one (1) year’s supply of lubricant.

3.13 MECHANICAL - ELECTRICAL COORDINATION

A. Equipment electrical current characteristics as shown on electrical drawings. Refer to article "Current Characteristics and Load Ratings of Motors and Equipment", Division 26, Section ELECTRICAL-BASIC MATERIALS AND METHODS.

B. The nameplate voltage of all motors furnished with mechanical equipment shall be within the range of the voltage shown for use with the motor as the upper limit, and 5% less than this voltage as the lower limit.

C. Each Mechanical Contractor shall furnish all motors, float and pressure switches, temperature control, other special automatic controls as noted in the HVAC and Plumbing Specifications, and all motor starters for all equipment furnished under their contract except where noted otherwise.

D. All starters shall be provided by the electrical contractor. Starters and fuses are sized based on the standard of design for the HVAC equipment. Should any piece of HVAC equipment change in model, size or manufacturer, and subsequently, the fuse, overload or starter size be required to be changed, the mechanical contractor, or contractor initiating such change shall bear all costs thereto, of the electrical contractor or any other contractor affected by such change.

E. All electrical equipment furnished by the Mechanical Contractors shall be as recommended by the Mechanical Equipment manufacturers, in accordance with the Electrical Specification for similar items, and of such type as to work properly with automatic temperature control sequences where required.

F. The Electrical Contractor shall provide all starters, combination starter disconnects, controllers, push-buttons, safety switches for motors, and wiring from starters to motors and install equipment furnished to them by mechanical contractors, unless otherwise indicated in the Mechanical Specifications.

G. Where controllers and/or starters are furnished as an integral part of any equipment, the contractor supplying the equipment shall furnish complete wiring between controllers, starters and motors.

H. Electrical Contractor shall provide disconnect switches for all equipment under all contracts, except where such switches are an integral part of equipment, or specified with such equipment.

I. Mechanical Contractor shall set all motors and furnish, set and pipe as necessary, float switches, temperature control and other special automatic temperature controls.

J. Mechanical Contractor shall provide all control wiring specified in their respective section of the specification. The Electrical Contractor shall provide all other wiring required for the completion of the work of the Mechanical Contractors.

K. Mechanical Contractor shall furnish the Electrical Contractor with complete wiring diagrams as required.

L. Any electrical work performed by either Mechanical Contractor or their Sub-Contractors shall be performed in accordance with the requirements of the ELECTRICAL Section of these specifications.

3.14 ELECTRICAL MOTORS AND STARTERS

A. All motors furnished by Mechanical Contractors, unless specified to the contrary in Mechanical Specifications, shall conform to the following requirements:

1. Characteristics, dimensions, tolerances, temperature rise, insulation, rating, noise, vibration, and all other characteristics in accordance with the latest standards of IEEE or NEMA.
2. Unless required by the driven unit, motors shall have normal starting torque, NEMA Design B characteristics. Horsepower rating of motors shall be equal to or greater than that required by driven equipment. Current density design of motor rating shall be limited so that overload protection provided by standard motor starters will be adequate to prevent damaging overheating during stall, single phasing or slightly prolonged acceleration.
3. Use NEMA Class A or B insulation with motor frames amply sized to prove 1.15 service factor and an ambient of 40℃. maximum. Insulation systems shall be designed for an average life of 60,000 hours.
4. Each motor shall be mounted on the same bedplate as the equipment driven and be complete with pulleys, slide rails or flexible couplings as required.
5. Each Contractor is responsible in each instance for the proper selection of motors of suitable characteristics with details submitted for approval to the Architect/Engineer prior to installation.

B. All starters furnished by all Contractors shall conform with the following requirements, unless specified to the contrary in the Electrical Specifications:

1. All starters for 3-phase equipment shall be fully enclosed, across-the-line type equipped with thermal overload protection for all three phases, low voltage protection, all necessary auxiliary contacts as required and indicating pilot lights. Starters which are controlled automatically shall have two-wire control with "ON-OFF-AUTO" switches. Starters which are controlled manually shall have 3-wire control with Start-Stop pushbuttons.
2. All 3-phase starters remotely controlled shall have 120 volt coils and control transformers with disconnecting means.
3. Starters for single phase motors shall be manual toggle switches with thermal overload protection and pilot light. Omit pilot light for unit heaters.
4. General Purpose NEMA-1 enclosure for indoor use under normal atmospheric conditions. Watertight enclosure NEMA-4 or NEMA-5 for outdoor use or where starters are subjected to the splashing or dripping of water.

C. All controllers, starters and other electrical components furnished as an integral part of any apparatus shall be furnished complete with integral wiring as required.

D. So far as is practicable, all motors and starters shall be of one manufacturer. Equal to General Electric, Westinghouse or Square D.

E. Submit motor and starter data sheet.

F. Refer to Specification Division 26 for further starter requirements.

3.15 ELECTRICAL PROVISIONS FOR PACKAGED MECHANICAL EQUIPMENT

A. Unless otherwise noted in Mechanical Specifications, all packaged equipment furnished by Mechanical Contractors shall be complete with the following electrical provisions:

1. General compliance with provisions of the preceding Article, ELECTRICAL MOTORS AND STARTERS.
2. All refrigeration compressor motors shall operate at 90% minimum power factor.
3. Starting electrical characteristics of all motors and/or starters as approved by local utility company and Electrical Engineer.

B. Local and National NBFU approved, factory installed and wired starting, operating and control equipment, terminating in terminal strip for single power wiring connections by Electrical Contractor/Sub-Contractor where required. These provisions shall conform with the ELECTRICAL Section of these specifications, generally and specifically, they shall include approved branch fuses for branch power circuits.

3.16 PIPING AND CONDUIT UNDER FLOORS

A. Wherever piping, conduit, ducts or piping enclosures are run under a floor slab on grade, the work is to be installed after the General Contractor has brought the sub-grade to the proper level.

B. The Mechanical and Electrical Contractors shall excavate and backfill for the installation of all of their respective work. The excavation of the sub-grade where required for the installation of the work shall be performed including that for piping, conduit, ducts and piping enclosures. When the installation is completed and satisfactorily tested, the remaining space shall be filled with crushed stone or other material similar to that to be used by the General Contractor for the sub-base. The backfill shall be stabilized by hand or pneumatic tamping as directed by the Architect/Engineer and shall be returned to the original sub-grade level.

C. No piping, conduit, ducts or piping enclosures shall be installed in the stone sub-base which is part of the General Contractor's work unless specific permission is granted by the Architect.

D. Where piping is noted to be installed in enclosures, such as split terra cotta pipe, necessary protection of the insulation, arrangement and installation shall be as hereinafter described in the detailed specifications.

E. Where required by drawing notes, specifications, or Electrical Code, conduits installed under floors shall be encased in concrete, conforming to that specified under "Cast-In-Place Concrete".

3.17 REMOVAL AND RELOCATION

A. Mechanical and Electrical Contractors shall perform all removal and relocation work required for completion of systems in their contracts.

B. Removals shown on drawings are a general indication only, and may not necessarily indicate the full extent of removals which may be required to complete this work.

C. Where existing partitions, walls, ceilings and floors are to be removed, all ducts, piping, conduits, materials, fixtures and equipment attached or fastened thereto or within shall be carefully removed.

D. Where work under this contract interferes with the existing construction, duct work, piping, conduit or equipment, remove all such materials and reroute to clear the obstruction. Provide additional piping, conduits, ducts, and material of the same design and quality if the piping and/or conduit is to be continued in use.

E. Disconnect and remove all accessible piping, conduit, duct work, materials, fixtures and equipment not required in the new systems. Plug all outlets at the main or riser connection.

F. Removed materials not desired by the Owner and not to be reset and not specified nor indicated to be reused, shall become the property of the Contractor and shall be promptly removed from site.

G. All demolition work is subject to the direction and approval of the Architect and shall be performed in such manner as not to interfere with the normal operation of the building.

H. Equipment Pad Removal:

1. The Mechanical/Electrical Contractor shall remove all concrete pads and equipment support structure material not indicated or specified for reuse. Concrete pads shall be removed to one (1) inch below adjacent concrete floor surface.
2. Reinforcement and anchor bolts shall be cut off at or below level of pad removal.

a. Resurface area level with adjacent concrete floor surface using a heavy duty aggregate concrete topping consisting of Portland cement Type I or Type III conforming to ASTM C150 with aggregate graded by weight to pass sieves as follows:

Fine	**(Thin Coat) or**	**Coarse**	**(Heavy Coat)**
/8”	100%	1/2”	100%
No. 4	95 – 100%	3/8”	30 – 50%
No. 8	65 – 80%	No. 4	0 – 15%
No. 16	45 – 65%	No. 8	0 – 5%
No. 30	25 – 45%		
No. 100	0 – 5%		

b. Topping mix shall contain a high range water reducing admixture (super plasticizer) ASTM C494, Type F or Type G.
c. Contractor shall coat surface with epoxy bonding agent prior to application of concrete topping.
d. Mix design shall produce a heavy duty concrete topping with the following characteristics:

Compressive Strength	5000 psi at 28 days
Slump	8" maximum
Water to Cement Ratio	0.44.

3.18 DEMOLITION

A. Disconnect, demolish, and remove Work specified in Division 23 Sections.

B. If pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.

C. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.

D. Work Abandoned in Place: Cut and remove underground pipe a minimum of 2 inches beyond face of adjacent construction. Cap and patch surface to match existing finish.

E. Removal: Remove indicated equipment from Project site.

F. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

3.19 MECHANICAL WORK EXPOSED TO WEATHER

A. General: Provide protection for the ferrous metal portions of mechanical work exposed to weather including equipped fans, piping and accessories, supports and other items.

3.20 SAFETY MEASURES TO BE TAKEN

A. The Architect/Engineer has not been retained nor compensated to provide design and construction review services relating to the Contractor's safety precautions or to means, methods, techniques, sequences or procedures required for the Contractor to perform their work. The Contractor will be solely and completely responsible for conditions of the job site, including safety of the people and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours. The Architect's/Engineer's observations of the Contractor's performance are not intended to include review of the adequacy of the Contractor's safety measures in, on or near the construction site. It shall be the Contractor's responsibility to comply with "Safety and Health Regulations for Construction", Volume 36, No. 75, part II of the Federal Register by the U.S. Department of Labor. Contractor shall be responsible for providing any such safety measures and shall consult with the State or Federal Safety Inspector for interpretation whenever in doubt as to whether safe conditions do or do not exist; or whether they are or are not in compliance with State or Federal Regulations.

3.21 MANUFACTURER'S RECOMMENDATIONS

A. The materials and/or equipment shall be installed in accordance with manufacturer's recommendations and instructions.

3.22 INTERFERENCES

A. Before making any installation, the work of the trades must be coordinated and the necessary changes shall be made to avoid interferences or improper effect on work to be performed by any other Section. In the event that interferences develop, the Architect's/Engineer's decision will be final and no additional compensation will be allowed for moving of misplaced piping, ducts, conduit and/or equipment.

3.23 CLEANING

A. Premises shall be maintained in an orderly fashion at all times during the construction period. Remove any cartons, containers, crates, etc., as soon as their contents have been removed, and remove the debris as soon as possible.

B. Each Contractor and/or Sub-Contractor who is responsible for execution of individual sections of work shall be responsible for the following:

1. Removal of all lumber, refuse, metal, piping and debris from site resulting from their work.
2. Cleaning drippings resulting from their work, etc., from finished work of other trades.
3. Cleaning, polishing, waxing of their work as required.
4. The cartons, debris, etc., shall be removed from the site and premises at the sole expense of the Contractor.

C. After testing, and acceptance of all work by the Architect/Engineer and the Owner, each Contractor shall thoroughly clean all equipment and material involved in their Contract to the satisfaction of the Architect/Engineer.

D. At the completion of the work, the Contractor shall clean the work, equipment, etc., free from dust, etc., and leave the work area in good housekeeping fashion in a manner acceptable to the Owner's Representative.

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E. All heating and cooling coils shall be free of residue and oil prior to start-up. Any extraneous cleaning and venting of the facilities caused by a failure to clean coils shall be the direct responsibility of the Mechanical Contractor.

3.24 OPERATING WITHOUT FILTERS

A. Do not operate or permit supply system to be operated without filters.

B. When directed, during construction period, operate system with the filters in place and the caulking complete.

C. Clean inside of ducts and equipment and perform the repairs with filters in place and the caulking of filter frames completed.

D. After construction is finished, replace the filters with second set of clean filters.

3.25 TEMPORARY HEATING

A. The Contractor shall make provisions for the use of any permanent heating equipment, ducts and fan systems required for temporary heat as soon as the building is enclosed, during the heating season.

B. The Contractor will be responsible for any heating and ventilating equipment used and shall pay for any labor and fuel required for their operation.

C. Under no circumstances shall any items of new air handling equipment be operated for temporary heat or ventilation without filters in place. If the unit is used before construction is completed, the filters shall be replaced before the building is accepted by the Owner. This set of filters shall not be considered as the spare set of filters hereinafter specified.

3.26 TEMPORARY LIGHT AND POWER

A. The Contractor shall provide temporary light and power feeders throughout the building during the construction as specified in the GENERAL CONDITIONS.

3.27 EXTRA MATERIALS

A. Filter Media:

B. Furnish two (2) extra complete sets of the specified filter media for each air-handling unit to be used after the construction phase. One (1) set shall be installed after the construction phase set has been removed and the second set shall be turned over to the Owner at the time of Building Owner's/Tenant's acceptance of the air handling system.

C. Fan Belts:

1. Furnish one (1) set of spare fan belts of proper size and type for each main air handling system. Spare belts shall be turned over to the Owner at the time of Owner's acceptance of the air handling system.

3.28 START UP AND SERVICING OF EQUIPMENT AND SYSTEMS

A. After work has been completed under the Mechanical and Electrical contracts, and prior to final acceptance tests, each Contractor shall have manufacturers or their authorized agents of the equipment and material installed, completely check their equipment and put it into actual operation. In each case, the respective Contractor shall have the manufacturers thoroughly check the complete installation of the equipment produced by them for proper and correct operation under the service intended.

B. Six (6) months after final acceptance of the work under each of the Mechanical and Electrical contracts, each of the Contractors shall have the manufacturers again check their equipment for proper operation and lubrication. Coincidentally, these contractors shall assure that the building custodian is properly instructed in the servicing of the equipment.

C. Prior to expiration of the guarantee period, each contractor shall check all equipment, materials and systems installed under their contract, make necessary adjustments and/or replacements, and leave systems in first class operating condition.

3.29 EXCAVATION AND BACKFILLING

A. Each Contractor shall perform all excavation, backfilling and pumping necessary for completion of work under their contract, unless noted otherwise. All excavation shall be considered classified.

B. Remove from premises, or deposit as directed by the Architect, all material excavated and not required or suitable for backfilling.

C. Carefully remove and store topsoil, shrubbery and sod until underground work is complete and trenches are backfilled and then re-install. Replace any damaged items to the satisfaction of the Architect.

D. Trench depth shall allow adequate cover over piping, ducts and conduit. Walls shall be perpendicular to the top of piping and ducts and conduit trench bottoms shall be instrument graded in the direction of flow as required. Earth shall be scooped out under pipe hubs to provide a solid bearing for the pipe duct or conduit on undisturbed earth. Cinder fill, stones or bricks beneath piping duct or conduit are prohibited.

E. Each Contractor shall provide sheathing, shoring and bracing in accordance with OSHA and local authorities' safety regulations as necessary to complete their excavation and backfilling work. They shall exercise every precaution necessary to prevent accident, injury or death to any human and damage to property of others. Remove all sheathing, shoring and bracing upon completion of work.

F. It shall be the responsibility of each Contractor to check with the various utility companies for location of their facilities in the work area and make the necessary arrangements to avoid damage to their property. Each Contractor is responsible for damage during excavation to existing piping or equipment. Such damage shall be repaired promptly without cost to the Owner.

G. Backfill after inspection and approval. Backfill shall be made with clean earth, free from rocks, frozen particles, debris or other foreign materials. Deposit in uniform layers not over six inches (6") thick with each layer mechanically tamped before the next layer is applied. When approved backfill material is not available from the site, each Contractor, at their own expense, shall provide additional select backfill to complete installation. Partial backfill on piping with all joints exposed is mandatory for all underground gas and underground domestic water systems. Final backfill only after testing procedures have been approved.

H. All trenches that pass under wall foundations shall be backfilled with lean concrete, full height, directly under wall footing, and at a 1:1 slope away from wall or column footing. Trenches that are parallel with and deeper than wall foundations shall be backfilled with lean concrete on a 1:1 slope away from the bottom of the wall or column footing.

I. Each Contractor shall perform all cutting and patching to sidewalks, curbs, bituminous paving, walls, etc. required by performance of excavation and backfilling. Install and maintain temporary paving as directed by the Architect/Engineer. Make repairs to sidewalks in complete blocks, partial patching will not be acceptable. Provide all materials for patching in strict accordance with applicable Articles of the General Construction Specifications.

J. Where rock is encountered during installation of underground piping systems, carry trenches to a point six inches (6") below invert of pipe and provide a six inch (6") layer of crushed stone or gravel as a cushion.

K. All excavation work shall include all pumping equipment, materials and labor necessary to keep all excavations free of water. Provide well points as required with disposition of water as directed by the Architect/Engineer.

L. Each Contractor shall provide suitable indemnity for all accidents to humans, animals or equipment caused by their excavating and backfilling work. They shall provide suitable guards, barricades, lights, red lanterns or flares and take the necessary precaution for an approved and safe installation. All trenches shall be backfilled at the end of each working day. Where a trench must be left open, provide coverings of adequate size and strength over entire open area.

END OF SECTION 230000

SECTION 23 01 20 - WATER SYSTEMS CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Flushing, cleaning, filling, venting and treatment of all hydronic piping distribution systems (heat pump loop).

1.3 SYSTEM DESCRIPTION

A. Design Requirements

1. Cleaning of water systems includes (but is not limited to) flushing and cleaning of all piping distribution systems that are part of this Project using a company specializing in cleaning and chemical treatment of HVAC piping systems.
2. After systems have been proven clean and initial chemical treatment of system has been performed, subsequent chemical treatment of water will be provided by Owner.

1.4 SUBMITTALS

A. Informational Submittals:

1. Qualification Data: Submit name, qualifications and references of water treatment service company.

B. Closeout Submittals:

1. Operation and Maintenance Data: For cleaning of water systems include all maintenance instructions for inclusion in project maintenance manuals.
2. Include report on initial system cleaning and treatment including copies of strainer cleaning log books, system fill volume, makeup water and system water test results, chemicals used (type and volume/mass), recommended and final chemical concentrations, and other pertinent water quality data as required to maintain system in optimum condition.

1.5 SERVICE AND WARRANTY

A. Provide monthly service for a period of one (1) year.

PART 2 - PRODUCTS

2.1 TREATMENT CHEMICALS

A. Provide approved system treatment chemicals as directed by Water Treatment Services Company.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping distribution systems.

B. Proceed with cleaning only after unsatisfactory conditions have been corrected.

C. Beginning cleaning constitutes Contractor's acceptance of systems and conditions.

3.2 FILLING, FLUSHING, VENTING, AND CLEANING

A. At all times from beginning of cleaning of water systems until final acceptance by Owner, provide free oxygen removal and chemical treatment of hydronic systems to protect system components against internal corrosion.

1. Do not fill hydronic-heating systems until firing equipment is operable and all aspects of installation are prepared for startup. Do not subject any system to water that has not been de-oxygenated for periods longer than 4 hours. Provide approved de-oxygenation strategy as required to remove free oxygen and prevent corrosion of boilers, cooling tower, pumps, other system components, and piping.

a. Heating water to provide for de-oxygenation of heating systems will be an acceptable procedure. Provide heated water to remove free oxygen and prevent corrosion and premature failure of boilers and piping. Start boilers as specified in Project Manual and in accordance with ASME Boiler and Pressure Vessel Code immediately upon filling and proceed to heat system water to at least 190 deg. F while circulating entire system at temperature for at least two hours and actively venting air.

2. Provide chemical feed tank connected across each system's pumps or as indicated on Drawings. Provide services of approved water treatment consultant to:

a. Obtain and coordinate with hydronic equipment manufacturers' published water quality guidelines as required to maintain equipment warrantees.
b. Test system water and make-up water during system flushing, cleaning, and venting and prescribe proper water treatment to clean system and maintain boilers, cooling tower, piping, controls, and all other hydronic specialties' warranties and prevent corrosion or deterioration of entire hydronic system due to oxygen, acid, scaling, or other water related problems.
c. Provide prescribed ingredients and maintain proper water conditions until acceptance of system. Turn over in manufacturers' approved condition.

B. Flushing and Venting:

1. Flushing and venting shall include each entire system, including portions of existing systems connected to, but not modified by, this Project.
2. Flush all piping with clean water at flow rate required to produce local pipe velocity of not less than 10 feet per second. Section by section flushing as required to achieve this velocity is required.
3. Note strainers will likely become clogged repeatedly during this phase of system operation. Repeatedly clean strainers as described below as required to maintain unobstructed flow. Strainer Cleaning:

   a. Remove, clean, and reinstall all strainer screens during and after flushing and venting (including screens of existing system strainers). Record strainer screen contents in log book. Repeat after a 2-week operating period connected to main system pumps.
   b. Insure all pump suction diffusers have fine mesh start-up screens prior to filling system. Remove and clean all pump suction diffuser screens whenever the pressure drop across screen is double the pressure drop of a clean screen and after 2-week operating period. Record strainer screen contents in log book.
   c. Reinstall strainer screens after cleaning. Reinstall fine mesh suction diffuser start-up screens each time they contain significant debris upon removal.
   d. Purge and vent all air from the systems introduced as a result of strainer cleaning.
   e. Submit strainer-cleaning report as detailed for cleaning report submittal.

4. Vent all air from hydronic systems.
5. Open all manual vents to relieve air and test operation of automatic air eliminators, and main automatic air vents.
6. Purge systems identified above section by section to flush residual air. Isolate piping sections and flush fluid through each section to drain or vent connections to accomplish purging. Legally dispose of drainage.
7. After each system has operated at full temperature for 2-week period and all leaks have been repaired, vent each system as specified above. Purge each system as specified above if necessary.
8. Repeat flushing and venting as necessary to remove all air from each system and install additional air vents as necessary to remove remaining air.

C. Cleaning: After each hydronic system has been leak-tested, flushed, and vented, clean system as specified below. Do not use system for temporary heat or submit for acceptance and use by

Owner prior to cleaning. Do not operate pumps continuously or unattended until system is flushed and strainers cleaned. Notify Owner's Project Representative before starting cleaning.

1. Cleaning Procedures:

   a. Clean all air vents, gauge glasses, control valves, etc. and ensure free operation.
   b. Use side stream filter across system pumps where indicated on Drawings to filter particulate from hydronic system during cleaning. Provide filter bags as required to remove all solids from system down to 5-micron size. Deliver 10 spare 5-micron filter bags to Owner.
   c. Provide cleaning compound of sodium carbonate and trisodium phosphate, in proportions of 1lb of chemical per 50 gallons of water or as recommended by system equipment manufacturers. Mix chemicals with water and introduce into the system per equipment manufacturer's and water treatment service companies instructions, filling entire system with cleaning solution. Provide temporary meter or other means (calculated volume acceptable) of determining amount of water in system. Provide all necessary valves, fill pipe, and similar components.
   d. Operate pumps and control system with control valves open. Circulate solution for heating system at 190 Deg. F. for at least 24 hours. Circulate solution for cooling and heat pump systems at ambient temperature for at least 24 hours. Flush and vent system as required during cleaning. Remove and clean air vents, strainers, filters, and check valves, and replace improperly functioning components. Blow down solids separators.
   e. After cleaning and blow down, circulate for additional 8 hours, then clean strainers, filters, and separator blow down again; repeat until strainers and filters are found clean, and solution taken from separator blow down is clean.
   f. Drain, flush cleaning solution with clean water, and legally dispose of drainage. Install additional drains if necessary to completely drain system.
   g. Refill with clean deoxygenated water.

2. Test for Cleanliness:

   a. Circulate for additional 24 hours and take water sample to test for cleanliness from any system low point drain or blow down valve by filling quart sample bottle and allowing sample to settle for 12 hours. Check for floating and settled impurities. Water is considered clean if no impurities can be observed in drawn samples, and 5-micron side stream filter bag remains nominally clean after 24 hours full flow circulation. Draw samples in presence of Architect and turn over to Owner to confirm cleanliness.
   b. Drain and repeat the starting up procedure and cleanliness test as often as required to pass "Test for Cleanliness".

3.3 FINAL FILLING OF WATER PIPING SYSTEMS

A. Water Hydronic Systems: Thoroughly purge and vent approved cleaned system. Provide prescribed chemical treatment and turn over in manufacturers' approved condition.

END OF SECTION 23 01 20

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and all Division 01 Sections, apply to this Section and to all of Division 23.

1.2 SUMMARY

A. This Section includes the following:

1. Definitions, references, and abbreviations.
2. General regulatory requirements.
3. General requirements regarding site/field conditions including existing conditions and field measurements.
4. Sequencing and scheduling including coordination.
5. Definition of design equipment and procedures for consideration of specified equivalents, proposed equivalents, or substitutions.
6. HVAC demolition.
7. Equipment installation requirements common to equipment sections.
8. Minimum material requirements and equipment verification.
9. Electrical components for HVAC Work
10. Concrete bases and grout.
11. Mechanical penetrations, waterproofing, and sealants.
12. Fire-stopping
13. Access doors
14. Painting and finishing.
15. General requirements for demonstration of completed systems

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. Design Equipment: Equipment, specified in Technical Specification Section or on Contract Drawings using applicable manufacturer's designation, that forms the basis for performance requirements, physical dimensions, configuration, and similar aspects used in the design of this Project including (but not limited to) physical configuration of surrounding construction and location of connections to other components.

G. Specified Equivalents: Products identified in Technical Specification Section that may provide performance complying with specified requirements but may not have the same arrangement, configuration, size, construction, or other aspects as the specified Design Equipment. Refer to Instructions to Bidders and Section 01 25 00 – Substitution Procedures for additional information and requirements regarding equivalents and substitutions.

H. Equivalents, Proposed Equivalents, Proposed Products: These terms may be used interchangeably and mean the same thing: Products NOT identified in Technical Specification Section that the Contractor proposes refer to Instructions to Bidders for instructions for proposing equivalents.

I. Heating and Cooling Work: Refers to Heating, Ventilating and Air Conditioning Systems and Equipment where used in technical specification sections of Division 23.

J. Plumbing Work: Refers to Plumbing and Gas Fitting Work where used in technical specification sections of Division 22.

1.4 ABBREVIATIONS

A. Abbreviations: Reference to technical society, organization, body or section made in Division 23 in accordance with the following abbreviations:

1. AIA American Institute of Architects
2. ADA Americans with Disabilities Act.
3. AMCA Air Movement and Control Association International, Inc.
4. ANSI American National Standards Institute
5. ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineers
6. ASME American Society of Mechanical Engineers International
7. ASTM American Society for Testing and Materials International
8. AWS American Welding Society
9. IBC International Building Code, Delaware Edition
10. IEEE Institute of Electrical and Electronics Engineers, Inc.
11. NEC National Electric Code
12. NEMA National Electrical Manufacturers Association
13. NFPA National Fire Protection Association

14. SMACNA Sheet Metal and Air Conditioning Contractors National Association
15. UL Underwriters Laboratories Inc.

1.5 SYSTEM DESCRIPTION

A. Provide complete systems, properly connected, tested, balanced, adjusted, and ready for operation, including all necessary and required controls, safeties, details and accessories, including (but not limited to):

1. Demolition and removals required for equipment and system installation.
2. Piping systems and related equipment.
3. Refrigeration systems and related equipment.
4. Ventilation systems and related equipment.
5. Support Systems and related equipment.
6. Insulation Systems and related equipment.
7. Miscellaneous items required for equipment and system installation.
8. Controls and electrical control wiring to equipment furnished in this contract.
9. Electrical power wiring to equipment furnished in this contract, where not covered elsewhere.

1.6 SUBMITTALS

A. General Division 23 submittal requirements:

1. Comply with requirements of Section 01 33 00 – Submittal Procedures and as modified below.
2. Product Data: Submit Product Data for items listed in individual technical section. Clearly identify manufacturer, pertinent design, function, materials, construction, and performance data specifically addressing specification description and Contract Document requirements of item. Strike out products that are not applicable to item being submitted, where more than one product is indicated on manufacturer product literature.

    a. Cover Sheet: Attach cover sheet, identified in Section 01 33 00, to Product Data of each item submitted. Provide cover sheet for only one type of item with related accessories, equipment with related components. Do not combine unrelated items under same cover sheet.
    b. Specified Equivalent Product Data: Submit manufacturer's product information including product literature, technical specifications and descriptions, performance data, and similar items to demonstrate compatibility with Basis-of-Design Equipment as specified in "Manufacturers" in Part 2 - Products below.

3. Coordination Drawings: Prepare Coordination Drawings in timely manner to comply with overall construction schedule. Refer to Sections 01 31 00 and 01 33 00 for more details.

    a. Prepare drawings coordinating HVAC systems, lighting fixtures, ceiling mounted devices, ceiling heights, materials, structural work, maintenance clearances,

electric code clearance, building systems, existing construction, etc. Provide additional details and sections, as required for clarity, at all places of potential conflict.

b. Deliver Coordination Drawings in accordance with requirements specified in Section 01 31 00. Indicate areas of conflicts between HVAC systems and other building components by highlighting locations on drawings and separately listing.
c. Reposition proposed locations of HVAC systems as required to work within project constraints. Adjust exact size, aspect ratio, location and offsets of ducts and pipes as required. Achieve as specified and other reasonable appearance objectives in open areas without ceilings without increase in Contract Sum.
d. Review of Coordination Drawings in accordance with Section 01 31 00 does not relieve Contractor from responsibility for coordinating HVAC systems with Project work, nor does it authorize extra cost, omission or deviation from Contract Document requirements. Costs arising from errors or omissions in Coordination Drawings shall be borne by Contractor.
e. Review Coordination Drawings and compare them with all other drawings to verify that all Work can be installed without interference. Notify Owner's Project Representative in case of unresolved interferences prior to installation of any work. Revise Coordination Drawings as required to eliminate installation interferences upon direction of Architect.

4. Do not proceed with installation of systems in each area until agreement is reached with all concerned on exact arrangements for each room or area, unless otherwise directed by Architect. If Contractor proceeds prior to resolving conflicts, Contractor shall modify installed Work as required to permit other systems to proceed with a coordinated installation.
5. Specified Equivalent Drawings: Submit detailed drawings of proposed Specified Equivalents, indicating proposed installation of equipment and showing maintenance clearances, required service removal space, and other pertinent revisions to arrangement and configuration shown in Contract Documents.

B. Shop Drawings: Include dimensioned plans, sections, and attachments to other work for concrete bases.

C. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

1. Grout
2. Sealants
3. Fire-stopping.
4. Access doors.
5. Painting and finishing.
6. Escutcheons.

D. Samples:

1. Submit color chart with paint manufacturer's color samples for final color selections prior to beginning painting. Comply with additional requirements for color selection samples specified in Division 09.

E. Quality Control Submittals:

1. Letters on manufacturer's letterhead from equipment manufacturers certifying that their equipment and systems have been installed in strict accordance with manufacturer's recommendations, properly aligned and adjusted, tested, lubricated, wired, balanced, etc.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements

1. Comply with applicable requirements of all Federal, State, and Local Building, Health, Plumbing and Electrical Codes, Laws, Ordinances and Regulations, including (but not limited to):

   a. International Building Code
   b. International Mechanical Code
   c. Delaware State Fire Code
   d. International Energy Conservation Code
   e. In event of a conflict between the Codes identified above and Contract Documents, comply with more stringent requirement.

2. Comply with applicable requirements of NFPA, utility company regulations, and following standards:

   a. Provide Underwriters Laboratories (UL) labels on all electrical materials carrying 50 volts or more.
   b. Provide refrigeration equipment complying with Safety Code for Mechanical Refrigeration (ASHRAE Standard 15 - and ANSI Refrigeration Safety Code B9.1).

3. Provide installation, testing and materials in accordance with all Federal, State and Local Building, Health, Plumbing and Electrical Codes, Laws, Ordinances, and Regulations that apply to HVAC Work.

B. Certifications: Obtain and pay for all necessary inspections and certificates from all applicable agencies. Perform all required tests in accordance with regulation of agency having jurisdiction. Submit certificates of approval prior to Final Completion as defined in Section 01 77 00 – Closeout Procedures. Submit certificates of approval prior to request for final acceptance of Contract.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Ship materials in manufacturer's containers, fully identified with manufacture's name, trade name, type, class, style, model, grade, size and color.

B. Storage and Protection

1. Store materials, equipment, fixtures, pipe, fittings, attachments, under cover, off ground in original containers as applicable, and protect from physical and weather damage while in storage and during construction.
2. Furnish extra materials identified in technical sections, in original manufacturer's containers and packaging, to Owner at location identified during Preconstruction Conference. Obtain receipt from Owner upon delivery of extra materials and send copy of receipt to Architect.
3. Replace or repair damaged, rusted, corroded or otherwise unusable materials physically damaged or weather damaged equipment as determined by Architect, at no change in Contract Sum.

1.9 PROJECT/SITE CONDITIONS

A. Existing Conditions

1. Reuse equipment only as indicated on Drawings.
2. All usable material and equipment not being reused is to be offered to the Owner. If accepted by Owner the Contractor shall deliver to a location on District grounds designated by the Owner.
3. All other material and equipment to be removed, shall be removed from the site and legally disposed of by the Contractor
4. Furnish new equipment and materials for all Heating Work in conformance with Contract Documents, including any material, operation, method or device mentioned, listed or noted within Division 23 Sections, unless specified as furnished or installed by all Contractors or others.

B. Field Measurements

1. DO NOT SCALE DRAWINGS; Heating Work drawings are diagrammatic. Refer to Architectural and Structural drawings for dimensions and details, and verify measurements in field before proceeding.

   a. Provide all required fittings, offsets, elevation changes, and similar items not indicated on Drawings. Do not infer that Drawings show level of detail indicating every offset, elbow, union, fitting, elevation changes, or other aspect required for complete installation.
   b. Install all items with proper provision for removal and access to coil bundles, boiler tubes, belts, valves, traps, filters, and similar components.

2. Layout of equipment, piping, and similar components in Drawings is diagrammatic. Review Drawings to identify interference with other construction and verify dimensions at Site prior to beginning installation.

    a. Obtain exact location of all items and openings and confirm all existing conditions in field. Review Shop Drawings of all Contracts.
    b. Coordinate all Heating and Cooling Work that interferes with other construction with other responsible Contractor.

    c. Obtain exact location and roughing requirements for all equipment furnished by others, but installed by this Contractor before roughing. Owner reserves right to make reasonable changes prior to "roughing-in" without increase in Contract Sum.

3. Report any conflicts to Architect in writing before beginning installation.

1.10 SEQUENCING AND SCHEDULING

A. Perform all Heating and Cooling Work in cooperation with Owner, Architect, Construction Manager, and all Contractors on this Project, and other separate Contractors at the Site.

1. Coordinate all Heating and Cooling Work with construction schedule requirements in Division 01
2. Coordinate all submittals with the construction schedule and with requirements and schedules contained in Section 01 33 00 – Submittals Procedures.
3. Immediately report any delays in receipt of materials required for Heating and Cooling Work including circumstances causing delays.

B. Existing Construction: Provide openings, chases, recesses, lintels and bucks required for admission of Heating and Cooling Work, unless otherwise noted. Do not cut waterproofed floors or walls for admission of equipment or materials without written permission. Do not pierce structural members without written permission.

C. New Construction:

1. Furnish necessary information, such as locations and sizes of heating construction, fixtures and equipment, to all Contractors in ample time for installation of openings, chases, recesses, lintels and bucks required for admission of plumbing construction, fixtures and equipment.
2. Furnish and install sleeves, inserts, panels, raceways, boxes, and similar components, ahead of General Work and provide Heating and Cooling Work representative during installation of General Work responsible for maintaining items in position.

D. Supports for Heating and Cooling Work: Furnish and install anchor bolts required supporting or securing Heating and Cooling Work. Locate settings and check locations as construction progresses. Provide templates or holding fixtures as required to maintain proper accuracy.

E. Cutting and Patching: Bear expense of cutting, patching, repairing or replacing of work of all Contracts required due to fault, error or damage by contractor responsible for Heating and

Cooling Work, unless otherwise specified in Contract Documents. Employ and pay Prime Contractor involved.

F. Refer to Division 01 for cooperation between Contractors. Prior to start of construction:

1. Obtain from Contract Drawings or Architect, exact location of items and openings in construction. Conform to existing conditions in field.
2. Review Shop Drawings of all Contracts.
3. If conflict occurs between Contract Drawings, advise Architect in writing before beginning installation and comply with Architect's directions.
4. Obtain exact location and roughing requirements for equipment furnished by other Contractor or by Owner, but installed by Contractor responsible for Heating and Cooling Work before beginning roughing.

1.11 COORDINATION

A. Pre-Installation Conference:

1. Attend pre-installation conference. Arrange for all subcontractors to be in attendance.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

E. Coordinate Heating Work with plumbing systems, lighting fixtures, ceiling mounted devices, ceiling heights, materials, structural work, maintenance clearances, electric code clearance, and building systems. Verify that Work of all Contractors can be installed without interference with Heating and Cooling Work.

F. Notify Architect in case of unresolved interferences prior to installation of Heating and Cooling Work.

G. Adjust exact size, location and offsets of exposed HVAC components to achieve reasonable appearance objectives without increase in Contract Sum.

H. Testing and Balancing: Cooperate with Contractor responsible for Testing and Balancing work as required ensuring complete and proper testing, balancing and adjustment of air and water systems.

1. Advise Architect in writing when systems and equipment are ready for testing and balancing.

2. Arrange for authorized representatives of specified equipment manufacturer to perform start-up, checkout, and testing of boiler and burners and automatic fire extinguishing and dust collection systems. Cost of manufacturer's start-up, checkout and testing included as part of Heating and Cooling Work.
3. Immediately prior to beginning of testing and balancing, provide following:

    a. Adjust all balancing cocks and dampers open.
    b. Fill, vent, and clean all water systems.
    c. Place all equipment in operating condition.
    d. Clean all strainers.
    e. Remove all temporary air filters and install design filters.

4. During course of adjusting, testing and balancing, provide following:

    a. Maintain qualified personnel at Project at all times for system operation, troubleshooting, assistance, and similar services.
    b. Change pulleys, sheaves and belts as required to meet system performance requirements.
    c. Perform necessary mechanical adjustments in conjunction with balancing procedure.
    d. Replace all balancing cocks, flow balancer and cock, and similar items that cannot be manipulated to satisfy balancing requirements.
    e. Make any changes or additions to Heating and Cooling Work incorrectly installed and which interferes with or adversely affects proper testing, balancing, or adjusting.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Equipment – Provide as specified with all options as required for full compliance.

B. Specified Equivalents - If Specified Equivalents (refer to "Definitions" in Part 1 above) are proposed, comply with following requirements:

1. Submit "Specified Equivalent Drawings" as specified in "Submittals" in Part 1 above.

    a. Provide required changes in design and adjacent construction or equipment at no increase in Contract Sum.

        1) Where required, provide larger motors, equipment, additional control devices, valves, fittings, and other miscellaneous equipment necessary for proper operation and provide proper location of roughing and connections to other Contractors.
        2) Provide additional motors, starters, power, wiring, and control wiring required.

3) Provide revisions to equipment, wiring, support structure, controls, valves, fittings, and other miscellaneous equipment.
4) Additional Architectural and Engineering work, coordination, and documentation.

b. If proposed arrangement for Specified Equivalent is rejected, revise to be compliant and resubmit or submit Basis-of-Design Equipment.

2. Submit "Specified Equivalent Product Data" as specified in "Submittals" in Part 1 above to demonstrate that proposed Specified Equivalent is equal to or better than Basis-of-Design Equipment with respect to all performance characteristics, including but not limited to durability, individual equipment operating costs, entire interrelated system operating costs, service access, noise levels, vibration levels, compatibility with Owner's other existing equipment to minimize parts inventory, aesthetics where applicable, and similar characteristics.

C. Proposed Equivalents and Substitutions: In addition to requirements described elsewhere in these Contract Documents, all proposed equivalent and substitution products being considered shall be subject to the Specified Equivalent requirements listed above.

2.2 MATERIALS

A. Minimum Material Requirements:

1. Construct potable water systems and equipment according to AWWA standards.
2. Provide electrical equipment and systems meeting UL standards and requirements of NEC.
3. Provide UL label on all equipment and material with listing service.
4. Material Flammability:

   a. Flame spread rating of 25 or less.
   b. Smoke developed rating of 50 or less.

5. Equipment Verification: Carefully check manufacturer's drawings and specifications as they affect their particular equipment; follow factory instructions for roughing, installation, connection, filling, lubrication, testing, balancing, adjusting, alignment, wiring, and start-up operation.

2.3 CONCRETE BASES AND SUPPORTS

A. Use 4000-psi f_c air entrained concrete, maximum #1 aggregate, all edges chamfered 1-1/2 inches, trowel finished, and properly consolidated to eliminate voids. Reinforce and secure to floor with #4 rebar dowels 18 inches O.C. 3 to 6 inches from edge around entire perimeter, inserted into structural slab 3 inches minimum and extending to within 1 inch of pad top. Enclose dowels with #4 deformed rebar ring around all dowels overlapped 18 inches minimum and bent in at ends 12 inches minimum, secured to dowels at center of pad height. Roughen

structural slab, and coat with cement grout before pour. Ensure all equipment bolt down locations are within reinforcement ring, extended into structural.

B. Set adjustable internal threaded concrete inserts at appropriate bolt-down locations before pouring equipment bases. Use expansion anchors extended into structural slab. If reusing existing concrete base, use expansion anchors. After leveling and anchoring equipment, fill equipment bases with grout as required.

C. Boiler Bases: 5-1/2 inches thick minimum, reinforced with 6x6-W1.4xW1.4 welded wire mesh, 1-1/2 inches from bottom at boiler rails and doubled over 12 inches on long edges so as to leave 1-1/2 inches cover.

D. All Other Equipment Bases: 3-1/2 inches thick minimum, reinforced with 6x6-W1.4xW1.4 welded wire mesh, minimum 1-1/2 inches cover, doubled over 12 inches on long edges, unless otherwise specified

2.4 GROUT

A. Description: ASTM C 1107, Grade B, non-shrink, non-metallic, high strength grout, suitable for interior and exterior, above and below grade applications.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.5 SEALANTS

A. Refer to the Division 07 Section on Joint Sealants for sealant product specifications.

B. Provide premium products specified for each application as appropriate. Submit Product Data for all proposed sealants with schedule of applications for review and approval.

2.6 FIRE STOPPING

A. Refer to Section 07 84 13 for additional firestopping product specifications.

B. Conform to Flame (F) and Temperature (T) ratings as required by local building code and as tested by nationally accepted test agencies per ASTM E814, UL 1479 or UL 2079.

C. Fire Stopping Characteristics

1. F Rating: Minimum of 1 hour rating but not less than fire resistance rating of assembly being penetrated.
2. T Rating: Based on measurement of temperature rise on penetrating item.
3. Fire Test Pressure Differential: Minimum 0.01 inches of water column.

4. Asbestos free, free of any PCBs and free of any lead.
5. Do not use any product containing solvents, or that require hazardous waste disposal.
6. Where subject to movement, provide flexible system to allow for such normal movement of building structure and penetrating item without affecting integrity or listing of firestop system.

D. Applicable products:

1. Provide products by one of the following:

   a. Grace Construction Products.
   b. RectorSeal Corporation.
   c. 3M Fire Protection Products.

2. Fire Stop Sealants: Fire and smoke rated, one component, silicone elastomer compounds.
3. Fire Stop Intumescent Wraps: One-part, non-sag caulking grade sealant fire resistive elastomeric sheet with aluminum foil on one side which expands to closure upon melting of plastic pipe or plastic coated wire during fire.
4. Fire Stop Intumescent Panels: Rigid fire resistive rated sheet goods with galvanized steel on one side and intumescent material on other which remains rigidly in place and expands to form fire resistant char during fire.
5. Fire Stop Intumescent Sealant: Fire and smoke rated, one component, latex elastomer compounds.
6. Fire Stop Pillows: Fire resistive rated bags filled with various combinations of mineral wool and intumescent materials as described above, designed for flexible future use of cable and wiring through penetrations of fire resistive construction while maintaining integrity of penetration through repeated use. Resists cold smoke and seals to closure on melting of plastic coated wiring during fire.
7. Fire Stop Intumescent Device: Fire resistive rated pipe collar type device with locking mechanism and anchor tabs which expands to closure of melting plastic pipe or plastic coated wire during fire.
8. Fill and Cavity Materials: Mineral fiberboard, mineral wool packing or foam backing rod recommended by manufacturer and as classified under category XHHW in the U.L. Fire Resistance Directory.
9. Forming materials: As classified under category XHKU in the U.L. Fire Resistance Directory.
10. Primer, Sealant and Solvent Cleaner: As recommended by firestop manufacturer.

E. Non-Fire Rated Sealants:

1. Non -Hardening Sealant: Polyurethane-based, 2-part elastomeric sealant, complying with FS TT-S-00227, Type 2 (non-sag), Class A; similar to “Sonolastic NP-II” by Sonneborn Building Products.
2. Sanitary Sealant: Acetoxy silicone sealant, white, complying with FS TT-001543A, Type 2 (non-sag), Class A, listed by NSF to be in compliance with No. F-51 "Plastic Materials and Components for Use in Food Equipment”, in compliance with FDA Reg. 21 CFR 175.300 A Resinous and Polymeric Coatings; similar to ASCS 1702F7 Sealant” by G.E. Silicones.

2.7 ACCESS DOORS

A. Refer to the Division 08 Section on access doors for access door product specifications.

2.8 PAINT AND FINISHES

A. Refer to Division 09 for paint and finish product specifications

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

A. Refer to Division 01 Section "Execution" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material at point of continued use or as otherwise specifically indicated.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and cap remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap all duct ends with same or compatible ductwork material.
5. Equipment to Be Removed: Disconnect and remove equipment and all associated accessories. Plug, cap, seal, and otherwise patch to match as required.
6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, protect, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational. Document any existing damage before removals.
7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is otherwise made unserviceable by adjacent or associated work or error, remove damaged or unserviceable portions and replace with new products of equal capacity and quality. Verify, document, and confirm pre-existing damage with Owner and Architect before beginning work.

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

E. Ensure each equipment manufacturer:

1. Carefully checks Contract Drawings and Specifications applicable to manufacturer's equipment before roughing.
2. Reports to Architect, before or when Shop Drawings are submitted, any discrepancies or conditions applied to manufacturer's equipment that prevents proper functioning, servicing, and other aspects of equipment operation.
3. Provides manufacturer's printed installation instructions for each piece of equipment.
4. Thoroughly instructs Contractor exactly how equipment should be installed, connected, lubricated, started, operated, and similar aspects to ensure all factory instructions are rigidly followed during installation of equipment.

F. Install, test, start, and operate equipment as instructed by manufacturer.

G. Submit written evidence from equipment manufacturer that manufacturer's equipment and systems have been:

1. Installed in strict accordance with manufacturer's recommendations.
2. Properly aligned and adjusted, tested, lubricated, wired, balanced, and similar operations

H. Equipment Connections

1. Provide final make up water, condensate, chilled water/glycol, heating water/glycol, drain, vent, refrigerant, and gas connections to all equipment as required.
2. Provide equipment waste, drip, overflow, bleed water, condensate, and drain connections extended to floor or roof drains or other approved points of discharge. Provide integral condensate pumps and appropriate piping for units where gravity condensate drain is not practical or possible.
3. Provide for Owner-furnished equipment. Refer to manufacturer's drawings and specifications for requirements of Owner-furnished equipment and verify connection requirements.
4. Connect equipment complete and ready-to-use, including all valves, piping, piping accessories, traps, pressure reducing and backflow prevention devices, gauges, relief valves, vents, drains, insulation, sheet metal work, controls, dampers, and similar components required.

I. Precautions Against Freezing: In addition to applicable requirements in Division 01, take all necessary precautions with equipment and systems to prevent damage to building, piping, equipment, and other components due to freezing and water leakage until final acceptance. Before freezing weather occurs, make certain all:

1. Safety features are properly functioning.
2. Freeze protection is tested and sensing elements are properly located.
3. Openings around outside grilles, louvers, and similar items are properly sealed; notify Architect in writing if openings are not adequately sealed.
4. Outside air dampers are tight fitting and operational, and damper motors are properly winterized.
5. Air systems are properly balanced.
6. Proper insulation is installed where required.

J. Concealment: Conceal all Work not specifically shown on the Drawings as exposed. Note piping risers may be shown outside of walls due to scale of drawing symbols – the general intent is for these pipes to be concealed within the general construction if possible or if not possible, to be within riser chases. If for any reason concealment is impossible, notify the Architect and obtain written approval before starting that part of the Work.

K. Exposed Items: Install exposed items as shown on Drawings or as approved by Architect. Obtain Architect's approval for final arrangement and appearance before installing items in areas without ceilings.

L. Damaged Components and Replacement: If pipe, duct, insulation, or any HVAC component or equipment is damaged in appearance or is otherwise unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 complete, Section 23 05 29-Hangers and Supports for HVAC Piping and Equipment.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.4 CONCRETE BASES

A. Provide concrete bases for all floor-mounted HVAC systems equipment, unless specifically indicated otherwise in Contract Documents.

1. Shape and size to accommodate equipment, with minimum of 6 inches clear pad all around perimeter unless otherwise required by equipment manufacturer.
2. Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to requirements of Project. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with anchorage.

3.5 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.6 MECHANICAL PENETRATIONS, WATERPROOFING, AND SEALING

A. Openings Through Roofs: Curbs are required for rooftop fans, piping and duct penetrations, etc. Roofing, flashing, and general waterproofing are the responsibility of the Contractor unless specifically indicated otherwise elsewhere in the Contract Documents. Refer to Architectural Drawings for related work by others.

1. Use factory pre-fabricated units as specified and noted on Drawings.
2. Caulk and waterproof neatly with additional material as required.
3. Employ the services of an approved roofing sub-contractor for all patching and/or new work indicated as part of the Heating Work.
4. Any roofing work performed under this Contract shall be performed in such a way as to not void any existing roofing warrantee. Additionally, whether there is a roofing warrantee currently in force or not for roof in area of new penetrations, all new penetration work shall be warranted leak free for a period not less than one year from final acceptance of project.

5. Provide structural support for roof deck around all roof deck penetrations larger than 12 inch x 12 inch, unless specifically indicated otherwise elsewhere on the Contract Documents.

B. Opening Through Outside Walls:

1. Guarantee all penetrations to be thoroughly air and watertight. Caulk and flash duct penetrations in accordance with specifications, details on Drawings, and as required.
2. Install louvers in accordance with specifications, manufacturer’s recommendations, and details, as required to achieve guaranteed air and watertight penetrations. Direct drainage to drip away from building surface.
3. Use special waterproof construction as directed.

4. Provide mechanical sleeve seals for piping penetrations.
5. Provide structural support for wall above all penetrations wider than 12 inches, unless otherwise indicated elsewhere on the Contract Documents.
6. Below grade openings:

    a. Provide mechanical sleeve seals for piping penetrations.

    b. Seal duct penetrations by filling space between duct and sleeves with approved non-hardening caulking compound. Openings to be caulked from inside and outside, before back filling.

    c. Seal below grade insulation system water tight to building foundation wall in accordance with insulation manufacturer's printed recommendations.

C. Openings Through Floors and Inside Walls: Provide through penetration systems for all mechanical work floor and wall penetrations which do not compromise the integrity of the floor or wall with regards to fire rating, smoke passage rating, acoustical noise reduction rating, or seismic rating. Insure through penetration system does not transmit mechanical vibrations to building walls or floors.

1. Provide structural support for floor deck around all penetrations larger than 12 inch x 12 inch, unless specifically indicated otherwise elsewhere on the contract documents.

3.7 FIRESTOPPING

A. Provide Through-Penetration Firestopping Systems and Devices listed in UL Fire Resistance Directory under categories XHCR and XHEZ and conforming to construction type, penetrant type, annular space requirements and fire rating indicated or required for each application.

B. Provide systems that withstand passage of cold smoke either as inherent property of system or by use of separate product included as part of UL system or device designed to perform this function.

C. Applied Fireproofing:

1. Coordinate the installation of hangers, supports and accessories from the structural steel with the Contractor responsible for fireproofing. Install all hangers and supports prior to fireproofing.

2. Any fireproofing removed as part of installing work under the Heating and Cooling Work Contract, the repair or replacement of that fireproofing is the responsibility of the HVAC Contractor.

    a. Employ the services of an approved fireproofing contractor to repair or replace the fireproofing by patching any areas that have been removed or damaged due to the installation of work after the completion of the fireproofing.
    b. Repaired or replacement fireproofing shall match the fireproofing adjacent to the repaired area. All warranties shall be maintained

3.8 ACCESS DOORS:

A. Provide all access doors shown on Drawings and as required for access to motors, dampers, valves, controls and all other devices requiring periodic inspection, adjustment or maintenance where located above or within inaccessible walls or ceilings except where access doors are indicated to be provided by others.

B. Engage skilled tradesman experienced in installation of access doors in applicable types of adjacent construction to install access doors. Install in accordance with requirements of Division 08 Section on access doors.

C. New Construction: Coordinate size and locations of openings required for access panels in walls, floors and ceiling construction with General Work Contractor in ample time for installation of access panels.

D. Existing Walls, Floors, and Ceilings: Cut and patch to install access doors in conformance with Section 01 73 00 - Execution.

3.9 PAINTING

A. Painting of HVAC systems, equipment, and components is additionally specified in Division 09 Sections on Painting.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

C. Vary initial and final coat colors slightly as required to provide positive identification between coats. Do not proceed with final coat until initial coat is properly cured per manufacturer's instructions, and has been approved as complete by Owner's Project Representative. Final coat shall completely conceal initial coat(s).

D. Paint Requirements:

1. Applications

a. Provide HVAC components exposed to view in finished spaces such as gymnasiums, classrooms, offices, corridors, etc., with factory finishes as specified elsewhere; refer to Division 09 for additional painting if required (exposed piping and duct in particular).

1) Provide touch up painting as required to repair or replace as directed, damaged factory finishes of HVAC components.

2. Paint all exposed metal surfaces that will be above 150 degrees F when in operation, with two coats of heat resistant paint.
3. Paint all miscellaneous fabricated ferrous supports complete.
4. Paint all ferrous piping and components located outdoors as specified in Division 09, except where insulation is to be applied over piping or component.

a. Where insulation is to be applied over exterior ferrous (steel) piping or components, first apply one full coverage coat of corrosion inhibiter equal to "Polyguard RG-2400".

5. Do not paint:

a. Chrome plated materials, aluminum and brass valves, or brass trim on iron body valves, stainless steel materials, copper indirect waste piping, and vent piping.
b. Piping above finished ceiling spaces, except un-insulated ferrous piping and supports.
c. Exposed copper pipe, brass valves, or brass trim on iron body valves, or machinery or equipment with factory-applied finish, unless otherwise specified.

6. Coating Systems: Comply with application and material requirements specified in Division 09.
7. Color Code Identification: Provide color code identification of mechanical piping in Mechanical Rooms by painting the following services as listed below.

	Item	Color
a.	Hangers, supports, base rails, etc.	Black

3.10 PROTECTION

A. Maintain systems during construction, temporary use, and until acceptance by Owner.

1. Properly lubricate all HVAC systems bearings during use.
2. Maintain limit controls, overload devices, and safety controls in operating condition during use

3.11 ALTERATIONS

A. Provide protection of existing facilities, demolition and removals, replacement and restoration, including patch-to-match requirements, and hazardous materials procedures to install Heating Work in conformance with Division 01 requirements.

B. Provide cutting and patching required to install Heating and Cooling Work in accordance with the requirements of Division 01 covering cutting and patching.

3.12 ADJUSTING AND CLEANING

A. Adjust all work as required to insure systems perform as designed and as intended, including but not limited to the following:

1. Adjust all diffusers to insure even air distribution free of objectionable drafts.

2. Adjust all hangers and supports to insure proper piping slope, alignment of flexible connections, even loadings, proper venting and draining, proper control over thermal expansion, etc.
3. Adjust all mechanical equipment insuring it runs properly as intended, providing the performance specified and required, and as required to maintain all warrantees.

B. Clean work furnished or provided as part of Heating and Cooling Work, including but not limited to equipment, control panels and devices.

1. Refer to and comply with Section 01 50 00 - Temporary Facilities and Controls for additional requirements for cleaning during construction and Section 01 77 00 – Closeout Procedures for additional requirements for final cleaning.
2. Remove debris, leftover piping, tubing, metal, insulation, cartons, papers, etc., resulting from Heating and Cooling Work.
3. Remove all rust, dirt, oil, etc. from Heating and Cooling Work to be painted and maintain in condition ready for painting.
4. Clean inside and outside of all equipment and distribution systems provided including (but not limited to) following:

   a. All enclosures.
   b. Remove all rust, oils, and similar contamination from all equipment, piping and supports to be painted, and leave components ready for painting.
   c. Remove debris, leftover piping, wiring, tubing, metal, insulation, cartons, papers, and similar items left in building or on Site. Clean building as often as necessary and when directed by Architect.

C. Final Cleaning: In addition to requirements specified in Section 01 77 00 – Closeout Procedures and other sections in Division 23, provide following measures.

1. Where heating units have been used to provide temporary heat, clean all permanent filters, replace all disposable filters, and clean all ducts, blowers, and coils.
2. Clean all piping strainers and replace all "startup" screens with permanent screens.
3. Refer to Section 23 01 20 – Water Systems Cleaning for detailed specifications.
4. Provide written notification to Architect upon completion of all final cleaning procedures and request inspection of final cleaning.

3.13 DEMONSTRATION OF COMPLETED SYSTEMS:

A. Prior to Final Completion, thoroughly demonstrate and instruct Owner’s designated representatives in care and operation of all heating and ventilating systems and equipment provided in Heating and Cooling Work. Provide necessary skilled labor to operate all systems for not less than 5 days and provide required instruction.

1. In addition to Contractor’s instruction, arrange for technically qualified factory representatives to train Owner's designated representatives in care, maintenance, and operation of following manufacturer’s equipment and systems.

   a. Temperature controls.

b. Heat Pump units.
c. Boilers / Burners.
d. Energy recovery equipment.
e. Cooling Tower.
f. Pumps.
g. Fire suppression systems.
h. Variable speed drives.

2. Coordinate and schedule time and place of all training through Architect at Owner's convenience.
3. Submit letters verifying satisfactory completion of all instruction including date of instruction, names of persons in attendance and countersigned by authorized representative of Owner.
4. Until final acceptance, Contractor retains full responsibility for systems operations and maintenance, even though operated by Owner's personnel during instruction, unless otherwise agreed to in writing.
5. During instruction, provide list, sealed in clear plastic, outlining operating, maintenance, and starting precautions and procedures to be followed by Owner for operating systems and equipment.

B. Lubrication Chart: Provide minimum 8-1/2 inch x 11 inch lubrication chart for all Work in Heating and Cooling Work Contract, typed in capital letters, mounted under clear laminated plastic, and secured to wall where directed by Architect.

1. List all motors and equipment including following information:

a. Name and location of equipment.
b. Type of lubrication recommended by manufacturer.
c. Lubrication period recommended by manufacturer.

2. Lubricate all motors immediately after installation and perform lubrication maintenance until final acceptance by Owner.

C. Air Filter Chart: Provide an air filter chart for all equipment installed in contract.

1. Chart shall be 8-1/2 inch x 11 inch minimum size, typed in capital letters, mounted under clear laminated plastic; secure to wall where directed.
2. List all equipment that includes filters in Contract. Obtain necessary information containing the following:

a. Name and location of equipment
b. Type of filters recommended by the manufacturer.
c. Size of filters for each piece of equipment.
d. Recommended replacement schedule from unit manufacturer.

END OF SECTION 23 05 00

SECTION 23 05 13 - COMMON ELECTRICAL REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. General requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
2. Starters and drive train accessories for electric motors.
3. Electrical auxiliary components required for HVAC systems that are not specifically identified in “E” series Drawings or Division 26.
4. Electrical wiring required for HVAC systems that is not specifically identified in “E” series Drawings or Division 26.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Baldor
2. General Electric
3. U. S. Motors

B. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

C. All motors shall be of premium efficiency design where applicable, as required to qualify for any available federal, state, or utility company energy efficiency rebate programs. Refer in particular to the Delaware NYSERDA programs.

1. Provide motors wound specifically for voltages as scheduled and available, with 1.15-service factor at rated voltage and frequency complying with all applicable NEMA standards.

D. Provide all motors suitable for 60 Hz operation.

E. Design motors 1/2 HP and larger and motors indicated as driven by variable speed drives, for operation on 3-phase power, voltage as shown on electrical plans, +/- 10 percent.

F. Design constant speed motors 1/3 HP and smaller for operation on single phase, 120 volts +/- 10 percent.

G. Comply with NEMA MG 1 unless otherwise indicated.

H. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS AND APPLICATIONS

A. Provide each motor suitable for continuous duty operation at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level, and suitable for speed, enclosure, rating, type and horsepower not less than as scheduled or specified in Contract Documents. Provide motor enclosure and maximum allowable temperature rise in degrees Centigrade over 40 deg. C ambient as follows, unless otherwise specified:

1. General Purpose: Drip-proof 40 deg. C or encapsulated design 60 deg. C.
2. Below grade level, roof-top unit, damp, high humidity, or condensing applications: Totally enclosed fan-cooled 50 deg. C or drip-proof encapsulated design 60 deg. C.
3. Motors, wiring, and disconnects installed in potentially flammable atmosphere: UL listed, NEC rated explosion proof construction, fan-cooled 50 deg. C rise.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Each equipment manufacturer is responsible for ensuring motors supplied with manufacturer's equipment are fully compatible with the application and capable of starting and running driven equipment without undue noise, heating, or distress.

2.3 POLYPHASE MOTORS

A. Single Speed General Application Motors:

1. NEMA MG 1, Design B, medium induction motor.
2. Efficiency: Premium efficiency, as defined in NEMA MG 1.
3. Service Factor: 1.15.
4. Random-wound, squirrel cage rotor.
5. Re-greasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
6. Insulation: Class F.
7. Temperature Rise: One class below insulation rating.
8. Motors 15 HP and Larger: NEMA starting Code F or Code G.
9. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
10. Enclosure Material: Manufacturer's standard rolled steel or cast iron enclosures corresponding to NEMA rating and application requirements.

B. Multi-Speed General Application Motors:

1. Similar to single speed motor requirements above, with separate winding for each speed.
2. Motors Used with Reduced-Voltage and Multi-speed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

C. Motors Used with Variable Frequency Controllers:

1. Motors shall meet all other requirements of this document, the driven equipment manufacturer, and the Variable Frequency Controller manufacturer, and be rated for this service with the drive and voltage intended. Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
2. All three phase motors for use with variable frequency controllers shall be special application, inverter duty premium efficiency motors of cast iron construction.
3. Ratings shall be in accordance with NEMA MG-1, Part 31 requirements for the specific application.
4. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
5. Class F temperature rise; Class H insulation.
6. Thermal protection via one Class F thermostat per phase, NEMA MG 1 compliant with requirements for thermally protected motors.

D. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.4 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.

2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Motors 1/20 HP and Smaller: Shaded-pole type.

C. Multi-speed Motors: Variable-torque, permanent-split-capacitor type.

D. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.5 MOTOR ACCESSORIES

A. For all new motor installations, whether in new equipment or installed as replacement motors, provide accessories listed below as required for a complete new drive system.

B. V-Belt Connected Motors: Provided with adjustable slide rail bases, motor sheaves, driven pulleys, and belts sized and applied such that total overhung load on motor shaft extension due to belt tension and motor torque does not exceed maximum overhung load allowed by motor design and construction.

1. Size and apply pulleys so that total overhung load on motor shaft extension due to belt tension and motor torque will not exceed maximum overhung load allowed by motor design and construction, with minimum 150 percent safety factor.
2. Motor and driven pulleys/sheaves to be premium quality, machined cast iron balanced to MPTA standards, tapered bushing bolted shaft connections, variable pitch diameter motor sheave through 10 hp motors (fixed sheaves 15 hp and above), multiple belt grooves and belts 5 hp and above and as required to maintain safety factor.
3. V-belts to be premium quality oil and heat resistant notched cog type belts with precision molded raw edges in matched lengths as required for application. Provide one extra set belts minimum for each motor, secured adjacent to drive or turned over loose to Owner.
4. Provide slide rail base to fit new motor for all new equipment motors, whenever replacement motor has different NEMA frame size from existing, or where specifically called for:

    a. Slide rail bases to be heavy gauge formed steel, adjustable with single adjusting bolt for belt tensioning, sized to fit motor.

C. Provide personnel guards to fit motor and drive for all new equipment motors, whenever replacement motor and drive do not fit existing guard, or where noted to provide guard on Drawings.

1. Personnel guards shall be of OSHA approved construction surrounding belts, shafts, and pulleys, with tachometer holes for motor and driven shafts.

D. Direct Connected Motors: Provide with flexible couplings if required by application and OSHA approved belt guards surrounding rotating machinery.

2.6 STARTERS

A. Manufacturers: Provide all starting equipment and control devices manufactured by same manufacturer and furnished through single responsible supplier unless otherwise specified in Contract Documents. Factory-wired or assembled packaged equipment may be provided with starting equipment of any acceptable manufacturer. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cutler-Hammer
2. General Electric
3. Square D

B. Provide starters, contactors, and controllers complying with applicable NEMA standards, minimum size 0, and enclosed in enclosures of type appropriate for environment where installed including general purpose, explosion proof, weather resistant, or weather-tight construction as required.

C. Ensure all parts subject to wear, arcing, and similar use are easily removable.

1. Provide necessary auxiliary contacts for each starter subject to electrical interlock or automatic control.
2. Equip magnetic starters for motors operating 208 volts and over, line-to-line, equipped with self-contained light loads imposed thereon with 120-volt secondary winding, grounded and having 120-volt starter operating coils.

D. Provide combination-type magnetic starters with fused disconnect switches. Fuse with class R fuses. Protect all starters with manual reset, solid state overload relay equal to (Square “D” motor logic) in one leg of single phase line to neutral circuits, in two legs of single phase line-to-line circuits, and in three legs of 3-phase circuits.

E. Provide 6-volt, red pilot light, integral transformer and long life bulb for all starters and contactors.

F. Manual Starters: Toggle operated, single pole for line to neutral circuits, two pole for line-to-line circuits, with thermal overload devices and neon pilot light; flush mounted unless shown otherwise, ganged with selector switch for multi-speed applications. Provide manual starters similar to one of the following:

1. Cutler-Hammer 9101
2. General Electric CR-101
3. Square D Class 2510

G. Combination Magnetic Starters: Single speed, across the line, HAND-OFF-AUTO selector switch in cover. Provide combination magnetic starters similar to one of the following:

1. Cutler-Hammer 9589
2. General Electric CR-107
3. Square D Class 8538

H. Magnetic Contactors: With control coil in series with temperature controls as required.

2.7 COMPONENTS

A. Electrical Wiring: Provide all materials conforming to NEMA Standards and UL approved for intended service. Refer to appropriate sections in Division 26.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine conditions under which materials and methods are to be installed and notify Architect in writing of any conditions detrimental to proper and timely installation. Do not proceed with installation until unsatisfactory conditions have been corrected in acceptable manner.

1. Installation indicates conditions are acceptable to Contractor as required to ensure requirements for applicable warranty or guarantee can be satisfied.
2. Motors and Starters: Confirm electrical characteristics for all equipment.
3. Electrical Wiring: Check all electrical wiring associated with equipment for compliance with specifications and correctness of connections. Correct wiring in event equipment or devices fail to function in specified manner, whether due to incorrect connections or improper information and wiring diagrams.

3.2 INSTALLATION

A. Motors and Starters:

1. Correct, at no additional cost, any misapplied motor or starter combination and improper thermal overload devices for motor starters provided as part of HVAC systems or components, along with damage to other equipment or construction.
2. Motors: Provide motors furnished by equipment manufacturer, specifically manufactured or selected for equipment served; mounted, and installed to provide complete installation that is substantially noiseless in performance under intended use. Replace motors unsatisfactory to Architect with new motor.
3. Starters and Accessories

a. Furnish properly tagged and identified devices specifically indicated on "Electric Equipment and Control Schedule" as supplied by HVAC systems suppliers and determine coordinated location and time for delivery of devices.
b. Provide auxiliary contacts required for temperature controls, interlock with other equipment, alarms, and similar components and applications.

B. Miscellaneous Electrical Wiring included in HVAC systems installations:

1. Provide all control wiring and power wiring for all equipment and associated control devices (including automatic control system) required for HVAC systems and components.
2. Comply with all applicable NEC requirements. Install all electric wiring in accordance with all local and state codes and regulations having jurisdiction.
3. Wiring for Controls: Provide wiring specified in Section 23 09 50 thru 23 09 59 – or all control devices required for temperature control system and other miscellaneous controls not included in "Electrical Equipment and Control Schedule".
4. Allow sufficient headroom under equipment as directed for each location (unit heater, etc.). Verify space available for each equipment item. Refer to Architect for any correction, discrepancy or suggested change in size of location.
5. Secure all equipment and fixture mountings, wiring devices, and accessories (clips, supports, etc.) to structure with screws, bolts, or similar items; nailing not acceptable.

END OF SECTION 23 05 13

SECTION 23 05 16 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Grooved-joint expansion joints.
2. Pipe loops and swing connections.
3. Alignment guides and anchors.

1.3 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.4 SUBMITTALS, GENERAL

A. General: Submit all action submittals and informational submittals required by this Section concurrently.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.

4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of expansion joint, from manufacturer.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 PIPE EXPANSION LOOPS WITH FLEXIBLE GROOVED COUPLINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Anvil International, Inc.
2. Shurjoint Piping Products.
3. Victaulic Company.

B. Description: Field-assembled expansion loop made of four 90 degree elbows with grooved-end flexible couplings, and grooved joints.

C. Standard: AWWA C606, for grooved joints.

D. Minimum Pressure Rating: 150 psig unless otherwise indicated.

E. Flexible Coupling: Ductile iron housing conforming to ASTM A-536, grade 65-45-12. Grade “E” EPDM gasket, temperature range -20 degrees F to 230 degrees F. Bolts and nuts to be heat treated plated carbon steel meeting ASTM A-449 and ASTM A-183 requirements.

F. Loop to have a minimum rated movement of +/- 1.5 inches from neutral position and imparts less than 50 pounds per inch of pipe diameter (example: 4-inch pipe x 50lb./in. = 200lb.

maximum) axial thrust on pipe system at design working pressure at full extension or compression.

2.2 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Adsco Manufacturing LLC.
   b. Flex-Hose Co., Inc.
   c. Hyspan Precision Products, Inc.
   d. Metraflex, Inc.

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

   a. Stud: Threaded, zinc-coated carbon steel.
   b. Expansion Plug: Zinc-coated steel.
   c. Washer and Nut: Zinc-coated steel.

5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.

   a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
   b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
   c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect risers and branch connections to mains with at least five (5) pipe fittings including tee in main.

C. Connect risers and branch connections to terminal units with at least four (4) pipe fittings including tee in riser.

D. Connect mains and branch connections to terminal units with at least four (4) pipe fittings including tee in main.

3.2 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 23 05 16

SECTION 23 05 19 - METERS AND GAUGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Liquid-in-glass thermometers.
2. Thermowells.
3. Dial-type pressure gauges.
4. Gauge attachments.
5. Test plugs.
6. Test-plug kits.
7. Sight flow indicators.
8. Venturi flowmeters.

1.3 SUBMITTALS

A. General: Submit all action submittals and informational submittals required by this Section concurrently.

B. Action Submittals:

1. Product Data: For each type of product indicated.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Informational Submittals:

1. Product Certificates: For each type of meter and gauge, from manufacturer.

D. Closeout Submittals:

1. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Trerice, H. O. Co.
   b. Weiss Instruments, Inc.
   c. WIKA Instrument Corporation - USA.
   d. Winters Instruments - U.S.

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and non-mercury blue or red organic liquid.
6. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: plastic.
8. Stem: Bare aluminum of length to suit installation.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing or Steel Piping: solid machined de-zincification resistant brass or stainless steel.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: ASME B1.20.1 pipe threads, size as required for sensors.
6. Internal Threads: ASME B1.1 screw threads, size as required for sensors.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length required to match thermometer bulb or stem.
9. Lagging Extension: Include on thermowells for insulated piping and tubing.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin unless otherwise required by sensor manufacturer.

2.3 PRESSURE GAUGES

A. Direct Mounted, Dial Type Pressure Gauges:

1. 4-1/2-inch diameter flat white dials with black characters and graduations, micrometer style or externally adjustable zero point, providing 0.5 percent accuracy at mid scale and 1.0 percent accuracy full scale, certified to ANSI (ASME) B40.100 grade 1A with scales reading in psig.
2. Direct drive helically wound inconel bourdon tube movement with sapphire jeweled bearings or liquid filled stainless steel rotary type movement, rated for pump-mounted service, with bourdon tubes of seamless phosphor bronze alloy with silbrazed tips and forged brass sockets.
3. Impact resistant ABS, drawn steel or cast aluminum case with blow out grommet, snap ring, and “shatterproof” acrylic lens.
4. Provide ranges to read maximum design pressure at between 1/2 and 3/4 of maximum range.
5. Provide combination vacuum pressure gauges where indicated or required.
6. Provide 1/4-inch NPT connections located at bottom, lower back, or center back as required.
7. Provide five-year warranty.
8. Products: Provide one of the following:

    a. “TLG” by 3D Instruments or equal
    b. Ashcroft Duradrive model 1288 or equal
    c. Wika 232.34DD series or equal.

2.4 GAUGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with, ASME B1.20.1 pipe threads and piston or porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass ball type or brass or stainless-steel needle type, with ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flow Design, Inc.
2. Trerice, H. O. Co.
3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
4. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.6 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. 3D Instruments, Inc.
2. Flow Design, Inc.
3. Trerice, H. O. Co.
4. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
5. Weiss Instruments, Inc.

B. Furnish one test-plug test kit containing two (2) thermometers, one (1) pressure gauge and adapter, and carrying case. Thermometer sensing elements, pressure gauge, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.

D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.

E. Pressure Gauge: One pressure gauge as specified above with insertion type adapter probe. Dial range shall be 0 to 100 psig.

F. Carrying Case: Metal or plastic, with formed instrument padding.

2.7 SIGHT FLOW INDICATORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Archon Industries, Inc.
2. Dwyer Instruments, Inc.
3. Emerson Process Management; Brooks Instrument.
4. Ernst Co., John C., Inc.
5. Ernst Flow Industries.
6. KOBOLD Instruments, Inc. - USA; KOBOLD Messring GmbH.
7. OPW Engineered Systems; a Dover company.

8. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball indicator and threaded or flanged ends.

D. Minimum Pressure Rating: 150 psig.

E. Minimum Temperature Rating: 200 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 INSTALLATION

A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.

G. Install valve and snubber in piping for each pressure gauge for fluids (except steam).

H. Install test plugs in piping tees.

I. Install flow indicators in piping systems in accessible positions for easy viewing.

J. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

K. Install flowmeter elements in accessible positions in piping systems.

L. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

M. Install thermometers in the following locations:

1. Inlet and outlet of each chiller, at chiller.
2. Two inlets and two outlets of each hydronic heat exchanger.
3. Each main return branch in equipment room.
4. Inlet and outlet of each boiler, at boiler.
5. Each of hot water supply and return branches in boiler room

N. Install pressure gauges in the following locations:

1. One (1) pressure gauge for each pressure reducing valve (PRV) on the make up water to each closed hydronic system with 3 isolation ball valves and snubber, piped to read pressure before and after PRV or atmospheric. Valve installed open to atmosphere for zero adjustment of each gauge.
2. One (1) pressure gauge for each pump with 4 isolation ball valves and snubber, piped to read pressure before suction diffuser screen, at pump suction, at pump discharge, and atmospheric. Valve installed open to atmosphere for zero adjustment of each gauge.
3. One (1) pressure gauge for each differential pressure sensor with 3 isolation ball valves and snubber, piped to read pressure in either supply, return, or atmospheric. Valve installed open to atmosphere for zero adjustment of each gauge.
4. One (1) pressure gauge for each hydronic expansion tank with 2 isolation ball valves and snubber, piped to read pressure in tank air or atmosphere. Valve installed open to atmosphere for zero adjustment of each gauge.
5. One (1) pressure gauge for each boiler with 3 isolation ball valves and snubber, piped to read pressure before and after boiler or atmospheric. Valve installed open to atmosphere for zero adjustment of each gauge.
6. One (1) pressure gauge for each side (heated and cooled) of each heat exchanger, two per heat exchanger, each with 3 isolation ball valves and snubber, piped to read pressure before and after heat exchanger or atmospheric. Valve installed open to atmosphere for zero adjustment of each gauge.

3.3 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance of meters, gauges, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy meter transmitters to meters.

3.4 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions. Coordinate calibration with Testing and Balancing Agency (TAB) and include results in TAB report.

B. Adjust faces of meters and gauges to proper angle for best visibility.

3.5 THERMOMETER TYPE SCHEDULE

A. Thermometers at supply and return of each hydronic zone shall be the following:

1. Direct-mounted, light-activated type.
2. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

B. Thermometers at inlet and outlet of each hydronic boiler shall be the following:

1. Industrial-style, liquid-in-glass type.
2. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

C. Thermometers at inlets and outlets of each Cooling Tower shall be the following:

1. Industrial-style, liquid-in-glass type.
2. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

D. Thermometers at inlets and outlets of each hydronic heat exchanger shall be the following:

1. Direct-mounted, light-activated type.
2. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

E. Thermometer stems shall be of length to match thermowell insertion length.

3.6 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Condenser-Water and Condenser Glycol Piping: 0 to 120 deg F.

B. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F.

3.7 PRESSURE-GAUGE TYPE SCHEDULE

A. Pressure gauges shall all be direct drive as specified.

3.8 PRESSURE-GAUGE SCALE-RANGE SCHEDULE

A. Scale Range for Building Condenser-Water Piping: 0 to 100 psi.

B. Scale Range for Condenser Glycol Piping: 0 to 160 psi.

C. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi.

END OF SECTION 23 05 19

SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Brass and bronze ball valves.
2. Iron, single-flange butterfly valves.
3. Iron, grooved-end butterfly valves.
4. Pump Discharge Valves
5. Bronze globe valves.
6. Air vent valves
7. Chainwheels.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 6 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 5 and smaller.
4. Chainwheel: Device for attachment to valve handwheel, gear actuator stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
2. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

2.2 BRONZE AND BRASS BALL VALVES

A. Two-Piece Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Conbraco Industries, Inc.; Apollo Valves.
   b. Milwaukee Valve Company.
   c. NIBCO INC.

2. Description:

   a. Standard: MSS SP-110.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Bronze.
   f. Ends: Solder or Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Stainless steel.
   i. Ball: Stainless steel, vented.
   j. Port: Full or Regular per application schedule.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Conbraco Industries, Inc.; Apollo Valves.
   b. Milwaukee Valve Company.
   c. NIBCO INC.

2. Description:

   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 150 psig.

c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 216 carbon steel, ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM/Teflon, reinforced, resilient, for water temperatures up to 250 deg. F at 150 PSI.
f. Stem: 316 or 416 stainless steel shaft mounted within corrosion resistant bearings.
g. Disc: Aluminum bronze, bronze, or nickel coated iron.

2.4 IRON, GROOVED-END BUTTERFLY VALVES

A. 300 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Anvil International, Inc; “Gruvlock”.
b. NIBCO INC.
c. Victaulic Company.

2. Description:

a. Standard: MSS SP-67, Type I.
b. NPS 8 and Smaller CWP Rating: 300 psig.
c. Body Material: Coated, ductile iron.
d. Stem: Two-piece stainless steel.
e. Disc: EPDM/Teflon coated ductile iron.
f. Seat: EPDM/Teflon, reinforced, resilient, for water temperatures up to 250 deg. F at 150 PSI.

2.5 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Milwaukee Valve Company.
b. NIBCO INC.
c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.

c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

2.6 CHECK VALVES

A. 1/2-inch to 2-inch Lines: Y-pattern swing-type manufactured in accordance with MSS-SP80, Class 125, bronze ASTM B-62 body with TFE seat disc; similar to "T413-Y (threaded) S413-Y (solder)" by Nibco.

B. 2-1/2-Inch Lines And Larger: Swing-type manufactured in accordance with MSS-SP71, Class 125, flanged ASTM A126 Class B cast iron body with bronze trim, non-asbestos gasket; similar to "F918-B" by Nibco.

C. Provide silent type where indicated and when check valves are installed in vertical lines.

1. 1/2-Inch To 2-Inch Lines: Bronze body, ball-cone check, straight through design, 1/2 PSI opening pressure, tight shut-off with liquid media, 125 PSIG steam rating; similar to "Apollo 61-100" by Conbraco.
2. 2-1/2-Inch Line And Larger: Globe type, semi-steel body with bronze trim and stainless steel spring, 125 lb. ASA. similar to "Fig. #105-MAP or #107-MAP" by Mueller Steam Specialty.

2.7 MANUAL BALANCING VALVES:

A. Provide combination globe-type calibrated flow measuring balance, shutoff, and throttling valve with provision for attaching portable differential pressure meter with each meter connection having positive shutoff access valves equipped with removable insulating cover providing minimum R of 4.5. Rated for 250 PSI at 250 deg. F and provided with calibrated nameplate, 1/4-inch drain/purge port, and drip-tight shut off. Similar to "CBV" by Armstrong, "3D" by B & G, or similar products by Tour & Anderson.

B. Threaded, grooved, or flanged ends as required to fit system piping with bronze body for pipe sizes 1/2-inch to 2-inches inclusive or cast or ductile iron body with bronze internal parts and Teflon or EPT seals rated for the service fluid and temperature for pipe size 2-1/2-inches and larger.

1. Valves designed to allow for presetting of balance points for proportional system balance prior to system start up.

C. Valve Size: As required to meet the Cv indicated on the Drawings, or if not indicated on Drawings, provide the larger of pipeline size or size required to provide maximum 5 ft. water gauge pressure drop at design flow.

D. Read-Out Ports: Include internal EPT inserts and check valves.

E. Adjustment Knob: Includes minimum of four full turns (1440 degrees) from bubble tight shutoff to full open position and includes pre-set feature indicating degree of valve opening including memory position stop and indicator.

2.8 AUTOMATIC FLOW CONTROL VALVES (AUTOMATIC BALANCING VALVE):

A. Provide each valve with an identification tag attached by chain, factory marked with the zone identification, valve number and flow rate. Valve to be line size.

B. The GPM for the automatic flow control valves shall be factory set and shall automatically limit the rate of flow to within 5 percent of the specified GPM over at least 95 percent of the control range.

C. For 1/2 inch – 2 inch, the flow cartridge shall be removable from the Y- body housing without the use of special tools to provide access for regulator change-out, inspection and cleaning without breaking the main piping.

D. Pump head requirement: The permanent pressure loss added to the pump head shall not exceed seven feet.

E. Each valve shall have two P/T ports.

F. Construction:

1. The internal wear surfaces of the valve cartridge must be stainless steel.
2. The internal flow cartridge body shall have machined threads so the spring free height may be compensated.
3. The internal flow cartridge shall be permanently marked with the GPM and spring range.
4. For 1/2” through 2” pipe sizes: An assembly shall consist of a brass Y-type body, integral brass body ball valve and ‘O’ ring type union. For all insulated pipe services, provide manufacturer’s pre-formed insulation cover to fit each valve, with extended, insulated, non-condensing handle on ball valves.
5. For 2 1/2” and larger flanged connections: Ductile iron body suitable for mounting wafer style between standard 150# or 300# flanges. The long flange bolts and nuts shall be provided with each control valve.
6. All valves shall be factory leak tested at 100 psi. air under water.

G. Flow Verification:

1. The differential pressure across the Automatic Flow Control Valve shall be measured for flow verification and to determine the amount of system over heading or under pumping.

H. Design Make: Flow Design Inc., Griswold or approved equal.

2.9 PUMP DISCHARGE VALVES

A. Combination triple duty globe type calibrated flow measuring balance, shutoff, throttling, and non-slam check valve with provision for attaching a portable differential pressure meter with each meter connection having positive shutoff access valves and equipped with removable insulating cover providing minimum R of 4.5.

B. Valves for constant speed pumps sized to provide maximum 5 feet water gauge pressure drop at the design flow.

C. Valves for variable speed pumping systems sized to larger of full line size or as required to provide maximum 3 feet water gauge pressure drop at the design flow.

D. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. "Model 3D Triple Duty Valve" by Bell & Gossett.
2. Armstrong.
3. Paco.
4. Victaulic.

2.10 AIR VENTS

A. Manual Air Vents:

1. For All Pipe Sizes In Accessible Locations Only: Bronze body, quarter turn ball valve with minimum 1/4-inch discharge and inlet connections. Provide collection chamber at inlet and 1/4-inch tube with return bend on outlet, piped to point of collection.
2. For Terminal Units In Accessible Locations: Bronze or brass body and non-ferrous internal parts, 150 PSIG working pressure, 225 deg. F operating temperature. 1/8-inch MNPT inlet connection. Coin or key operated, supply three keys minimum to owner. Similar to "Model 4V" by Bell & Gossett.

B. Automatic Air Vents:

1. High Capacity Type: Cast iron body with internal working parts of stainless steel, brass, bronze, and EPDM and float-operated sealing valve designed to purge free air from the system and provide positive shut off at pressures to 125 PSIG and temperatures to 250 deg. F. Vent prevents air from entering the system if system pressure drops below atmospheric. Vent readily serviceable by disassembly to access the internal working parts. Similar to "Model "107A" by Bell & Gossett or "720" by Amtrol.
2. Standard Capacity Type: Cast bronze body with internal working parts of stainless steel, brass, bronze and EPDM and float operated sealing valve designed to purge free air from the system and provide positive shut off at pressures to 150 PSIG and temperatures to 230 deg. F. Vent prevents air from entering the system if system pressure drops below atmospheric. Vent readily serviceable by disassembly to access the internal working parts. Similar to "No. 700-C" or "701-C" by Amtrol.

2.11 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to butterfly valve stems.
3. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve. Include zinc coating.
4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install isolation valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Install isolation valves at each new branch connection serving three or more pieces of terminal equipment, and as additionally shown on drawings.

C. When installing solder-joint end valves, protect valve body from soldering heat using water soaked rags or other heat sink method as required to avoid valve damage. Leaking stems or seats on solder-joint end valves shall be subject to immediate replacement with new valve.

D. Locate valves for easy access and provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above center of pipe.

F. Install valves in position to allow full stem movement.

G. Install all Automatic Air Vents with discharge piped to point of collection - for glycol venting, pipe discharge to glycol feed station as shown, or if not shown to minimum 1 quart clear plastic container, secured and removable for service.

H. Install all Manual Air Vents with air collection chamber above flow piping (minimum line size diameter x 6 inches long), and minimum ¼" tube extended to accessible location, terminating with ball valve located so liquid discharged during venting may easily be collected in minimum 1 quart container.

I. Install chainwheels on operators for butterfly valves more than 96 inches above floor. Extend chains to no higher than 48 inches above finished floor, or longer as required to hang on adjacent wall hook out of the way.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Hydronic Flow Shutoff Service: Full Port Ball or Butterfly valves.
2. Hydronic Vent and Gage Shutoff Service: Standard or Full Port Ball valves.
3. Hydronic Drain Service: Full Port Ball valves with ¾" hose thread end and chained cap.
4. Provide line size manual adjustment balancing valves for service on branch main lines serving multiple terminal loads, where shown on drawings.
5. Provide line size automatic flow control balancing valves for all individual terminal loads. Size valve flow cartridges based on approved equipment submittal flow rates where different from that scheduled. Include in contract changing cartridges on 10% of automatic flow control valves to some different flow as required during TAB and system commissioning work.
6. Pump Service: Provide Pump Discharge Valves by Pump Manufacturer, full line size of system piping (typically larger than pump discharge size). For VSD driven pumps, the pump discharge valve may alternately consist of a combination of a venturi measuring station as specified in section 23 05 19, a non-slam check valve, and an isolation valve. Provide isolation valve at pump inlet before flex connections and suction diffuser.

7. Air Venting:

   a. Provide High Capacity Automatic Air Vent above each air and air/solids separator:
   b. Provide Standard Capacity Type Automatic Air Vent at accessible points in piping system where air may collect, including all local high points and at the end of each horizontal run before a drop in elevation.

      1) If any such point will be inaccessible after construction is complete, provide Manual Air Vent in lieu of automatic, installed as described above.

   c. Equipment Vents:

      1) Boilers: Provide High Capacity Automatic Air Vent.
      2) Equipment Above Mains: Connect run outs or risers to upper quadrant or top of mains. Install vent assembly at branch high point, concealed within enclosure if possible, consisting of 1 in. diameter by 6 in. long air collection chamber with 1/4 in. soft copper tube to manual valve. Mount securely near bottom of enclosure, but not fastened to enclosure. For individual units, fan convectors and units with return grilles: Provide coin air vent valve, operated from discharge grille or access door. Positioning of valve shall not interfere with removal of enclosure.
      3) Equipment Below Mains: Connect piping run outs or risers to bottom or lower quadrant of mains. Vent assembly not required in unit. Provide means of purging and draining each unit. Use tees instead of ells at low point of run outs.

B. If valves with specified CWP ratings are not available, the same types of valves with higher CWP ratings may be substituted.

C. Select valves with the following end connections:

   1. For Copper Tubing, NPS 2 inch and Smaller: Threaded or solder joint ends.
   2. For Copper Tubing, NPS 2-1/2 inch and larger: Flanged ends.
   3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
   4. For Steel Piping, NPS 2-1/2 inch and Larger: Flanged or grooved ends.

3.5 HEATING CONDENSER-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

   1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
   2. Ball Valves: Two piece, full port, brass or bronze with stainless-steel ball and trim.
   3. Bronze Swing Check Valves: Class 125, bronze or nonmetallic disc.
   4. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron, Single-Flange Butterfly Valves.
2. Iron, Grooved-End Butterfly Valves.
3. Iron Swing Check Valves.
4. Iron, Grooved-End Check Valves.

END OF SECTION 23 05 23

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes

1. Hangers and supports for (but not limited to) following components:

   a. Piping hangers and supports
   b. Duct hangers and supports
   c. Equipment hangers and supports

2. Roof mounted supports and equipment penetrations including (but not limited to):

   a. Roof curbs.
   b. Combination equipment / pipe penetration curbs
   c. Pipe curb assembly
   d. Equipment support rails
   e. Pipe and duct supports

3. Miscellaneous components and accessories including (but not limited to):

   a. Anchors
   b. Guides
   c. Fasteners
   d. Custom supports
   e. Insulation protection systems

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Provide corrosion resistant construction as described below for hangers, hanger rods, supports, fittings, hardware, etc, unless otherwise noted or approved. Note that not all products described below are available in corrosion resistance as required for all applications listed – select

appropriate corrosion resistant products as required. Multiple conditions may apply, in which case the more corrosion resistant construction is required:

1. General purpose indoor: ASTM B-633 Fe/Zn 25 minimum zinc plated fasteners, ASTM B-653 G90 minimum sheet steel, factory baked enamel paint, or anodized.
2. In contact with copper: Copper plated for size identification and felt lined or plastic coated.
3. In contact with aluminum: Same aluminum alloy as equipment or 300 series stainless steel. 300 series stainless steel fasteners.
4. Outdoors, in crawl spaces, manholes, pits, and below grade: 300 series stainless steel or pre-drilled ASTM A-153 hot dipped galvanized steel, minimum coating thickness 3 mils.
5. Miscellaneous fabricated custom supports, anchor bases, etc..: painted in accordance with Section 23 05 00 – COMMON WORK RESULTS FOR HVAC.
6. Other special conditions: where noted on drawings, provide materials of special temperature, corrosion resistance, or other properties, as required for durable and safe performance.

B. Allowable Working Loads:

1. Use only manufacturer's load rated hangers, supports, and fasteners designed and rated for the intended service.
2. Do not load connectors, hangers, or supports to more than the manufacturers' recommended working load or the following:

   a. Use a safety factor of 5:1 minimum with respect to manufacturers' published ultimate shear strength.
   b. Use a safety factor of 10:1 minimum with respect to manufacturers' published ultimate tension or pull-out strength.

C. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, service loads, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's product literature, technical specifications, and other data required to demonstrate compliance with specified requirements for following components:

1. Hangers and supports
2. Roof mounted supports
3. Miscellaneous components

B. Shop Drawings: Submit intended custom support construction for approval.

C. All supports, etc., shall meet the approval of the Architects / Engineers. Submit shop drawings showing fabrication and installation details including calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.
5. Include detailed layout and loading drawings for all above roof piping and equipment.

1.6 QUALITY ASSURANCE

A. Comply with applicable requirements of following standards for all hangers and supports:

1. MSS-SP-58 Pipe Hangers and Supports – Materials, Design, and Manufacture.
2. MSS-SP-69 Pipe Hangers and Supports – Selection and Application.
3. ANSI / ASME Code for Pressure Piping B 31.1
4. ASTM standards for corrosion resistant Zinc coatings.
5. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
6. UL 203 Standard for Pipe Hanger Equipment and Fire Protection Service
7. Metal Framing Association MFMA-2
8. ANSI/ NFoPA NDS - National Design Specification for Wood Construction
9. SMACNA – Sheet Metal and Air Conditioning Contractor’s National Association, Inc.

B. All welding shall be approved procedures performed by approved welders. Refer to Division 05 Section for “STRUCTURAL STEEL FRAMING”, and Section 23 21 13 – HYDRONIC PIPING, for details on welder’s qualification requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. For convenience, details and specifications have been based on product types as defined in MSS SP-58 and 69 where applicable, and, where not applicable, catalog numbers shown have been based on products by the listed manufacturers.

2.2 PIPING ATTACHMENTS

A. Individually Suspended Horizontal Rigid Piping or Tube Attachments:

1. Band type:

a. 1-1/4 inch diameter pipe size and less only.
b. Formed steel loop overlapped at top with rod sized hole or insert nut. With or without side insert closure.

c. MSS SP-58 type 5, 6, or 10.

2. Clevis type:

a. Any size pipe or tubing.
b. Formed steel bands top and bottom connected by sheer bolt.
c. MSS SP-58 type 1.

3. Provide products by one of the following manufacturers:

a. B-Line Systems, Inc., Highland Illinois, or equal
b. ERICO/Michigan Hanger Co.; Solon, Ohio, or equal
c. Grinnell Corporation; Pipe Support Division, Cranston, Rhode Island, or equal.

B. Group Supported or Suspended (Trapeze) Horizontal Rigid Piping or Tube Attachments (Common Support Beam):

1. Support frame or trapeze beam of load rated brackets or channel strut product.
2. U-Bolt type:

a. Any size pipe or tubing.
b. Insulation support system rests directly on beam or shim, with U-bolt or split strut clamp upper restraint. Designed to accommodate minimal longitudinal movement only.
c. U-bolt MSS SP-58 type 24, Strut clamp similar to B-Line “B-2000” series.

3. Radius Roller type:

a. Any size pipe or tubing.
b. Radiused roller and steel axle with end sockets for double rod applications. Provide with U-bolt upper restraint. Designed to accommodate longitudinal movement through roller action.
c. Roller MSS SP-58 type 41 and U-bolt MSS SP-58 type 24.

4. Angled Roller type:

a. 6 inch diameter pipe size and less only.
b. Angled rollers with steel axles and formed steel angle clips designed for channel strut mounting. Provide with U-bolt upper restraint. Designed to accommodate longitudinal movement through roller action.
c. Roller similar to B-Line “B218” or “B219” and Strut clamp similar to B-Line “B-2000”.

5. Provide products by one of the following manufacturers:

a. B-Line Systems, Inc., Highland Illinois, or equal
b. ERICO/Michigan Hanger Co.; Solon, Ohio, or equal
c. Grinnell Corporation; Pipe Support Division, Cranston, Rhode Island, or equal.

C. Individual Vertical Rigid Piping and Tube Attachments:

1. Split Ring type:

   a. 1-1/4 inch diameter pipe size and less only.
   b. Cast malleable iron split ring with steel pivot and bolt, cast boss on one side threaded for standard rod or pipe attachment. Designed to accommodate minimal longitudinal movement only.
   c. MSS SP-58 type 12.

2. Riser clamp type:

   a. 1-1/2 inch diameter pipe size and larger.
   b. Twin formed steel bands with formed radius to fit pipe and extension wings drilled for clamping bolts, space between extension wings designed to accept various connections to building structure.
   c. MSS SP-58 type 8.

3. Provide products by one of the following manufacturers:

   a. B-Line Systems, Inc., Highland Illinois, or equal
   b. ERICO/Michigan Hanger Co.; Solon, Ohio, or equal
   c. Grinnell Corporation; Pipe Support Division, Cranston, Rhode Island, or equal.

D. Flexible Pipe, Tube, or Hose:

1. Lengths three feet and under to be supported by adjacent piping system.
2. Similar to attachments for rigid piping systems described above, with “V” notch bottom in lieu of radius, and associated continuous rigid trough angle of same material spanning between attachments.

E. Pipe Alignment Guides:

1. Steel Spider Clamp Type.

   a. 2-1/2 inch diameter pipe size and larger.
   b. Twin steel bands with formed radius to fit pipe, drilled for clamping bolts, welded extension “spider” wings sized to slide axially in matching welded and bolted outer housing ring with structural attachment legs.
   c. Similar to “No. 650" and “No.651" by ERICO/Michigan Hanger

2. Provide products by one of the following manufacturers:

   a. B-Line Systems, Inc., Highland Illinois, or equal
   b. ERICO/Michigan Hanger Co.; Solon, Ohio, or equal
   c. Metraflex; Chicago, Illinois, or equal.

F. Pipe Anchors:

1. Anchor Chair Type.

   a. Steel Pipe 1/2 inch and larger.
   b. Structural steel channel with V-notched flanges and U-bolt clamping device.
   c. Similar to Figures “B3147A" and “B3147B" by B-Line Systems, Inc.

2. Anchor Clamp Type.

   a. Steel Pipe 1/2 inch and larger.
   b. Formed steel with radius to fit pipe, holes for clamping bolts, welded gusset reinforced as required, complete with matching base plate.
   c. Similar to Figures “B3256" with “B3257" by B-Line Systems, Inc.

3. Riser clamp type.

   a. Steel pipe and copper tube size 1-1/2 inch and larger.
   b. Twin formed steel bands with formed radius to fit pipe and extension wings drilled for clamping bolts, space between extension wings designed to accept various connections to building structure.
   c. MSS SP-58 type 8.

4. Solder type.

   a. For copper tube 1-1/4 inch and under.
   b. Wrot copper formed band with radius to fit tube, drilled for clamping bolts, complete with matching base plate.
   c. Similar to “copper anchors” by Metraflex

5. Provide products by one of the following manufacturers:

   a. B-Line Systems, Inc., Highland Illinois, or equal
   b. ERICO/Michigan Hanger Co.; Solon, Ohio, or equal
   c. Metraflex; Chicago, Illinois, or equal.

2.3 DUCT HANGERS AND SUPPORTS:

A. Per SMACNA Duct Manual standards for size, height, and location of ductwork, and as noted below.

1. Materials and corrosion resistance as listed above.
2. SMACNA load tables allow for no external loads on duct: provide for 200 lb external load on all duct hangers and supports. Increase hanger and support sizes from SMACNA tables accordingly:

   a. Minimum band size 20ga. x 1 inch.

b. Duct 48” wide and larger; provide trapeze style support of metal channel framing or angle iron, suspended from threaded rods.

3. Hanger bands to extend down sides and turn under bottom 1 inch minimum for all duct sizes. Minimum (2) #10 sheet metal screws per hanger (one each on side and bottom), (2) screws minimum on sides for duct over 12 inches tall, 12 inches on center max.
4. Round exposed duct: hang from twin half round bands and rods, or as otherwise detailed.

2.4 BUILDING ATTACHMENTS:

A. Structural Steel Connectors:

1. C-Clamp style:

a. FM approved, U.L. listed, steel or malleable iron C-clamp with hardened set screw and lock nut, tapped for rod size, typically eccentrically loads structure.
b. Hanger rod bypasses structure: MSS SP-58 type 19.
c. Hanger rod in line with set screw: MSS SP-58 type 23.

2. Center Loading Beam and Channel Clamp Style:

a. Forged or formed steel or malleable iron construction, beam clamps with connection for concentrically loading structure, of types as required by loading and configuration.
b. MSS SP-58 types 21, 27, 28, 29, and 30.

3. Pivoting or Adjustable Connection Style:

a. Structural welding lug with forged steel clevis, side beam bracket, or other appropriate pivoting beam clamps as required for sloped steel.
b. Use for sloped steel, where thermal movement requires pivot, where seismic controls requires non-moment building connection, and elsewhere as required.
c. MSS SP-58 types, 21 or 22 with 16 or 17, 34, 57 with 14, etc...

4. Provide products by one of the following manufacturers:

a. B-Line Systems, Inc., Highland Illinois, or equal
b. ERICO/Michigan Hanger Co.; Solon, Ohio, or equal
c. Grinnell Corporation; Pipe Support Division, Cranston, Rhode Island, or equal.

B. New Concrete Connectors:

1. Cast in Place Insert Style:

a. Carbon steel or malleable iron concrete insert, tapered slot retains internally threaded nut. Insert 12-inch x 1/2-inch reinforcing rod through top of insert in pipes 6 inch and larger.
b. MSS SP-58 type 18.

2. Cast in Place Threaded Stud Type:

    a. Steel threaded rod inserted through steel deck before concrete pour, nut on both sides of deck to retain before pour, with offset at top for positive connection to cured concrete consisting of bent rod, welded top plate, nuts/washer, etc.
    b. Similar to “Model No. 370A" by ERICO/Michigan Hanger.

3. Provide products by one of the following manufacturers:

    a. B-Line Systems, Inc., Highland Illinois, or equal
    b. ERICO/Michigan Hanger Co.; Solon, Ohio, or equal
    c. Grinnell Corporation; Pipe Support Division, Cranston, Rhode Island, or equal.

C. Existing Concrete Connectors

1. Self-energizing tapered expansion bolt/sleeve: GSA specification FF-S-325, Group II, Type 3, Class 3, UL Listed, FM approved, complete with split expansion sleeve, washer, and hex head nut; similar to “Rawl Lok/Bolt” by Rawlplug.
2. Dual-Interlocking Expansion Wedge Stud: GSA specification FF-S-325, Group II, Type 4, Class 1, UL Listed, FM approved, complete with split expansion sleeve, washer, and hex head nut; similar to “Rawl-Stud” by Rawlplug.
3. Dual-Interlocking Expansion Wedge Threaded Rod Anchors: UL Listed, FM approved, complete with split expansion sleeve; similar to “Rod Hanger Wedge Anchor” by Rawlplug.
4. Provide products by one of the following manufacturers:

    a. Hilti, Inc.; Tulsa, Oklahoma, or equal
    b. Ramset/Red Head; Michigan City, Indiana, or equal
    c. Rawlplug Co. Inc.; New Rochelle, New York, or equal.

D. Hollow Masonry, Hollow Concrete, Pre-cast Plank Connectors

1. Toggle Bolt Type: GSA specification FF-B-588C,Type 1, Class A with ultimate load capacities meeting or exceeding load capacities for hollow concrete block in conformance with ASTM C-90; similar to “Rawl Toggle Bolt” by Rawlplug.
2. Epoxy/Screen tube type: Manufacturer’s load rated epoxy resistant to the chemical exposure of the application and capable of developing the ultimate strength of the threaded rod used, with stainless steel screen tube designed specifically for use with epoxy anchors in hollow masonry. Use manufacturer’s recommended mixing/injection device. Similar to the “Foil-Fast”, “Chem-Fast”, and “Chem-Stud” systems by Rawlplug.
3. Through bolt, nuts, square plate steel washer (thickness equal to half bolt diameter, width equal to six diameters minimum).
4. Provide products by one of the following manufacturers:

    a. Hilti, Inc.; Tulsa, Oklahoma, or equal
    b. Ramset/Red Head; Michigan City, Indiana, or equal
    c. Rawlplug Co. Inc.; New Rochelle, New York, or equal.

2.5 MANUFACTURED METAL FRAMING SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Allied Tube & Conduit.
2. Cooper B-Line, Inc.
3. Flex-Strut Inc.
4. Unistrut Corporation; Tyco International, Ltd.

B. Description: Factory, shop, or field-fabricated support assembly made of steel channels, accessories, fittings, and other components, factory stock or custom designed and assembled for supporting diverse mechanical components.

C. Standard: MFMA-4.

D. Channels: Load rated continuous slotted steel channel with in-turned lips.

E. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

F. Corrosion resistance as described above.

2.6 EQUIPMENT SUPPORTS

A. Custom Metal Framing Systems, Special Hangers and Supports:

1. Provide custom designed hangers and supports to properly support all contract equipment as required by special circumstances encountered.
2. Use structural carbon steel plate and shapes, secured by welding or bolts as required.
3. Fabricate as required to transmit loads and reaction forces to structure, in accordance with applicable details and layouts shown on Drawings, and as approved by Architect. Submit load calculations and fabrication details for approval for all such supports including verified coordinated dimensions, weights, etc., of mechanical component, support component, and building structure proposed.

2.7 MISCELLANEOUS COMPONENTS AND ACCESSORIES

A. Piping Anchor and Guide Bases:

1. Provide custom designed piping anchor and guide bases as required to properly transmit the piping reaction forces to the building structure.
2. Triangulate fabrication to transmit reaction forces to deck edge of structure or other approved anchorage. Submit fabrication details for approval for all such supports including verified coordinated dimensions of support components and building structure proposed for attachment.

3. Use structural steel plate and shapes of pipe wall thickness minimum, with pipe diameter leg dimension minimum, secured by welding or multiple bolts of the pipe's hanger rod size minimum. Increase dimensions as required due to excessive unsupported length (greater than 15 pipe diameters) or moment bearing (bending) design.
4. Secure to at least two structural members, using at least three points of attachment designed to transmit both longitudinal and lateral piping reaction forces.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

C. Threaded Rods, Bolts, Nuts, Washers, Metals, Hardware, and Miscellaneous Assembly Components:

1. Provide manufacturer's load rated fasteners with size, strength and corrosion resistance as required for the application.
2. Rods, bolts, machine screws: rolled forged ANSI B1 Class 2A or better thread, bolts and screws with heads as required by the application.
3. Nuts: heavy pattern where space permits and where subject to repeated operation, ANSI B1 Class 2B or better thread.
4. Washers: US pattern where space permits, SAE pattern otherwise, with toothed or split lock washer when attached to equipment with moving or vibrating parts.
5. Sheet metal screws: self drilling, thread forming, hardened steel (hardened SS as required), load rated screws with hex heads designed for power driving
6. Structural Steel: ASTM A 36/A 36M, carbon-steel, black and galvanized, and/or series 300 Stainless Steel plates, bars, angles, channels, and other shapes in thickness and size as required for load.

D. Piping Insulation Protection Systems:

1. Type "A" Insulation Protection System:

   a. 1" piping and smaller only.
   b. Steel Insulation Shield, minimum 18 gauge, 12-inch long, 180 degree circumference, sized for insulation thickness.
   c. MSS SP-58/69 type 40.

2. Type "B" Insulation Protection System:

   a. 1¼" through 8" heating piping only.
   b. Steel Insulation Shield sized as required by the load and compressive strength of the pipe support insulation, minimum 18 gauge, 12-inch long, 180 degree circumference, sized for insulation thickness. MSS SP-58/69 type 40.
   c. Pipe Support Insulation: High density (20 pcf). molded fiberglass blocks consisting of fiberglass wool and urea-phenolic resin cured binder. Provide number and size of support blocks as required to limit deflection to 1% and avoid long-term damage to vapor barrier, and as required for pipe size and insulation thickness, in

accordance with manufacturer's written guidelines and project details. Seal cut in piping insulation vapor barrier using manufacturer's recommended matching tape. Similar to AHAMFAB H-Block" by ICA

3. Type "C" Insulation Protection System:

   a. Acceptable for any size heating or cooling piping.
   b. Manufacturer's assembly consisting of insulation shield, high compressive strength insulation, and vapor barrier covering. May include hanger also.
   c. Hanger: As required above, secured to shield and support insulation.
   d. Insulation Shield: Rolled steel sized as required by the load and compressive strength of the pipe support insulation, minimum 18 gauge, 12-inch long, 180 degree circumference, sized for insulation thickness. MSS SP-58/69 type 40.
   e. High Compressive Strength Insulation: 180 or 360-degree circumference insulation insert formed of water resistance treated hydrous calcium silicate (untreated cal-sil not acceptable) or cellular glass insulation, same thickness as adjacent insulation.
   f. Vapor Barrier Covering: White kraft outer surface bonded to aluminum foil, sandwiching reinforcing fiberglass skrim yarn, permanently treated for fire and smoke safety and to prevent corrosion of the foil, with a vapor transmission perm rating of 0.02 or less. Seal to piping insulation vapor barrier using manufacturer's recommended matching tape.
   g. Similar to Models "123", "124", "1031", and "4031" by ERICO/Michigan Hanger.

4. Provide products by one of the following manufacturers:

   a. B-Line Systems, Inc., Highland Illinois, or equal
   b. ERICO/Michigan Hanger Co.; Solon, Ohio, or equal
   c. ICA Inc.; Lehighton, Pennsylvania, or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine conditions under which hangers and supports are to be installed and notify Architect in writing of any conditions detrimental to proper and timely installation. Do not proceed with installation until unsatisfactory conditions have been corrected in an acceptable manner.

   1. When Contractor confirms conditions as acceptable to ensure proper and timely installation and to ensure requirements for applicable warranty or guarantee can be satisfied, submit to Architect written confirmation. Failure to submit written confirmation and subsequent installation will be assumed to indicate conditions are acceptable to Contractor.
   2. Identify any discrepancies between specifications and field conditions or changes required due to specific equipment selection, prior to installation. Corrective work required by discrepancies after installation at Contractor's expense.

3.2 GENERAL INSTALLATION

A. Provide complete hanger and support systems for piping and ductwork systems and equipment, including all necessary attachments, fasteners, threaded rods, bolts, miscellaneous hardware, and associated work as required.

B. Provide specified products, installed in accordance with applicable sections of this specification, in accordance with the manufacturer's recommended installation instructions, and as detailed on the Drawings.

C. Support pipe, duct, and equipment from the building structure.

1. Provide approved miscellaneous support structure as required to attach hangers and supports to building structure in conformance with all applicable standards and related specification sections.
2. Do not use chain, perforated hanger strapping or band, wire hangers, or kinked, bent, or otherwise damaged hangers and supports.
3. Do not support one pipe from another, one duct from another, pipe from duct or equipment, or any similar combination.
4. Install lateral bracing with pipe hangers and supports as required to prevent swaying.
5. Provide special hangers and supports as shown on the drawings, as required to suit existing conditions, and as required for proper installation of equipment.

D. Coordinate the installation with applied fireproofing and where possible install attachments to structure prior to fireproofing. Where prior installation is not possible, repair fireproofing as required.

1. Repair or replace any fireproofing removed or damaged during installation of components.
2. Ensure repaired or replacement fireproofing continuously matches or exceeds rating of adjacent fireproofing and ensure that all warranties are maintained.

E. Load Distribution: Install hangers and supports so that live and dead loads and stresses from movement will not be transmitted to connected equipment.

3.3 PIPE HANGER AND SUPPORT INSTALLATION

A. Comply with MSS SP-58 and MSS SP-89 and as specified below. Install hangers, supports, clamps, and attachments as required properly supporting piping from the building structure.

B. Trapeze Pipe-Hanger Installation: Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from manufactured slotted channel system or structural shapes selected for loads being supported.

C. Size piping attachments for insulated piping to fit outside insulation. Size piping attachments for un-insulated piping to fit outside diameter of pipe.

D. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping. Provide for slope of trapeze supported piping systems with adjustable individual piping attachments.

E. Accommodate thermal movement of piping systems.

1. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
2. Provide rods of sufficient length for ample swing. Hang rods from high points to allow maximum swing.
3. Hang piping so that rods are vertical at the design temperature.
4. Where length of rod and thermal expansion combine to cause more than 4 degrees angular movement of rod (or 1 inch lateral movement in a 12 inch rod), provide suitable linkage to permit swing and limit rods to tensile loading only, or, provide pipe roll.
5. Where length of rod and thermal expansion would combine to cause more than 10 degrees angular movement of rod (or 2 inch lateral movement in a 12 inch rod), provide pipe roll.
6. More thermal movement is expected as the straight line distance from piping anchor points increases. Unless unusually long hanging rod length allows swing as indicated above, provide pipe roll hangers and supports at or above the following distances from piping anchor points indicated on drawing or installed in field. Deviations from below values subject to pre-approval:

Piping Service English		Distance from Anchorage
a.	Individual Copper Cooling Service	100 ft.
b.	Individual Copper Heating Service.	35 ft.
c.	Trapeze Copper Cooling Service	60 ft.
d.	Trapeze Copper Heating Service.	20 ft
e.	Individual Steel Cooling Service	140 ft.
f.	Individual Steel Heating Service.	60 ft.
g.	Trapeze Steel Cooling Service	80 ft.
h.	Trapeze Steel Heating Service.	50 ft
i.	Trapeze with both Heating and Cooling Service	20 ft.

F. Threaded Rod for Pipe Hangers:

1. Double nut each end of each rod. Threaded clamp, turnbuckle, etc., counts as one nut.

2. Rod size for individual pipe hangers and two rod / two pipe trapeze style supports:

Rod size:	for Pipe size:
3/8”	2” and smaller.
1/2”	2-1/2" and 3".
5/8”	4" and 5".
3/4”	6".

3. For multiple pipe trapeze style supports with two rods for more than two pipes, size rods according to manufacturers recommended safe working loads taking into account total hung weight, 200 pound live load, as well as capacity of structure; each rod not smaller than size shown above for largest pipe in trapeze. Submit details of all such supports and connectors for approval before construction, including schedule of proposed sizes and capacities.

G. Pipe Hangers and Supports Spacing (Maximum):

1. Provide hanger or support as close as possible to and within 24 inches of any elbow.
2. Provide hanger or support on branch pipe within 24 inches of main at takeoff / tee.
3. All Horizontal / Sloped Heating and Cooling Piping Systems:

Piping Material	Maximum spacing of hangers
a. Copper ¾ in. and smaller	5 ft.
b. Copper 1 in. and 1-¼ in.	6 ft.
c. Copper 1½ in. and larger	8 ft.
d. Steel 1¼ in. and smaller.	7 ft
e. Steel 1½ in.	9 ft.
f. Steel 2 in. and larger	10 ft.
g. Annealed copper	3 ft.
h. Flexible piping or hose	Continuous

4. Vertical Piping:

a. Steel and Copper 1¼ in and smaller	Two per floor level.
b. Steel and Copper 1½ in and larger	One per floor level.

H. Insulated Piping

1. Center insulation shields at piping attachments and secure shield from lateral movements by wrapping PVC tape around circumference of piping insulation and shield at both ends of shield.
2. At all piping attachments, provide piping insulation protection system of strength and configuration required to guarantee integrity of pipe insulation and associated vapor barrier. Refer also to SECTION 23 07 00 INSULATION.

3.4 BUILDING ATTACHMENTS INSTALLATION

A. Fastener Systems: Provide screws, bolts, approved anchors, etc., to secure piping, duct, equipment, supports, and miscellaneous components and accessories to structure. Nailing not permitted.

1. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 3" and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
2. Minimize eccentric loading of structure as follows:

   a. For paired point loads eccentrically suspended (C-clamp attached supply and return pipes, etc), suspend from opposite edges of structural member.

   b. For point loads over 400 pounds, use center loading beam clamps or other structurally concentric building attachment, and confirm proposed configuration with Engineer by submittal.

3. For connections cast in place to new concrete, assume concrete strength as specified. Do not apply loads to freshly cured concrete until written approval is received from contractor responsible for concrete strength.
4. For connection to existing concrete:

   a. Connect only to sound concrete free of evidence of deterioration.
   b. Do not install connections or apply loads to recently cast curing concrete until written approval is received from contractor responsible for concrete strength. Use compressive strength certified by ASTM approved test results.
   c. For older existing concrete and in the absence of ASTM approved tests certifying otherwise, assume a concrete compressive strength of $f'c = 3000$ psi.
   d. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Do not use powder-actuated fasteners in precast concrete or in pull-out tension.

5. For connection to wooden structures: Apply NDS criteria to all structural wood connections.

3.5 DUCT HANGERS AND SUPPORTS:

A. Install per SMACNA duct manual and as modified by the requirements of this section.

B. Provide support spacing per building structural system but not greater than 8 feet. Provide extra support structure as required.

3.6 ELECTRICAL WORK HANGER AND SUPPORT INSTALLATION

A. Refer to Division 26 complete.

3.7 METAL FRAMING AND EQUIPMENT SUPPORT INSTALLATION

A. Provide miscellaneous metal, beams, angles pipe bars, structural steel shapes, bases, braces, etc. accessories required to attach hangers and supports to walls, floors, structural members, etc. in conformance with Section 05 12 00 – "STRUCTURAL STEEL FRAMING".

B. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

C. Custom Hangers and Supports: Install as required by special circumstances encountered, in accordance with applicable details and layouts shown on Drawings, and as approved by Architect.

D. Provide lateral bracing to prevent swaying for equipment supports.

E. Provide vibration isolation, seismic restraint, and thermal movement capability for hangers and supports. Refer to Section 23 05 48 – MECHANICAL SOUND, VIBRATION, AND SEISMIC CONTROL.

F. Grouting: Place grout under supports for equipment and make bearing surface smooth.

G. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

H. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.8 ADJUSTING

A. Adjust all hangers and supports after installation of piping and associated equipment to distribute loads equally on attachments and to achieve proper pitch for the applicable piping system.

B. Trim excess length of continuous-thread hanger and support rods as required - avoid hazardous protrusion.

3.9 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 23 05 29

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.5 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, function, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Pipe Label Contents: Include identification of piping service using abbreviations indicated below, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

D. Piping Systems: Identify the following systems as indicated:

1. Heating Hot Water Supply (HWS)
2. Heating Hot Water Return (HWR)
3. Natural Gas (G)
4. Condenser Water Supply (CWS)
5. Condenser Water Return (CWR)
6. Condensate Drain (CD)

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.5 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Fiberboard or metal.

2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

2.6 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.7 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

B. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 15 feet along each run.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

	Item	Color
1.	Heating hot water…….....	Dark Red
2.	Natural gas……...OSHA Safety Yellow	
3.	Hot water supply & return……...Brown	
4.	Condenser water supply……	Blue
5.	Hangers, supports, base rails, etc……	Black
6.	Condensate (drain)……..	Rust Brown

3.4 DUCT LABEL INSTALLATION

A. Install plastic-laminated duct labels with permanent adhesive on air ducts.

B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

1. New construction: Provide a neat typewritten valve directory listing valve function, location and identification number. Minimum size to be 8-1/2 by 11 inches, incased within plastic laminate. Mount securely where directed.
2. Valve Numbering System: Extension of and compatible with existing valve numbering system, where valves are installed in existing building or in addition to existing building. Do not duplicate existing numbers; verify existing numbers in the field
3. Verification: Verify existing valve numbers in field and provide valve numbering avoiding duplication of existing numbers.

B. Valve Identification For New Construction:

1. Provide 1-1/2 inch diameter brass tag with brass jack chain (#16).
2. Stamp "H" and valve number for each main, riser, zone, and branch heating valve and at all other valves whose function is not readily apparent.
3. Stamp "C" and valve number for each main, riser, zone, and branch cooling valve and at all other valves whose function is not readily apparent.
4. Provide a special tag at compression tank(s) shut off valve with legend as follows: "Always keep this valve open except when draining compression tank"

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Testing, Adjusting, and Balancing (TAB) Work shall be performed by a fully qualified independent TAB Agency as described in "Quality Assurance" Article and as approved by the Architects, to be paid for by the Contractor responsible for HVAC Work.

1. TAB Work shall be a joint effort of the Contractor and the TAB Agency, performed with the intention of leaving the systems involved in a properly functioning and balanced flow condition as designed and indicated in the Construction Documents.
2. The division of responsibility for the TAB Work shall be as outlined below. The Contractor shall perform preparation work and has the option of subcontracting a portion of this to the TAB Agency, but the TAB Agency shall take sole responsibility for any portion of the work defined as the TAB Agency's work.

B. Section includes preparation for, and Testing, Adjusting, and Balancing (TAB Work) of HVAC components, equipment, and systems:

1. Preparation:

a. Contractor shall place systems in satisfactory operating condition as detailed below prior to the arrival of the TAB Agency for the specified TAB Work, and shall notify the TAB agency, Construction Manager, and Engineer in writing when systems are ready for TAB Work.
b. TAB Agency shall review Construction Documents and Coordination Drawings with Contractor and assist in preparation of submittals, particularly Coordination Drawings, dampers, and balancing valves, by preparing recommendations to Contractor and Engineer on locations of balancing valves, dampers, access doors, test connections, etc., as well as any other special considerations affecting the TAB Work and/or the fabrication or engineering of the systems. Documentation of assistance shall be both by mutually agreed upon notations on the submittals / sheet metal Shop Drawings prior to submittal, and by TAB Agency's letter accompanying submittal, verifying review and TAB Agency approval. Contractor shall make changes as required to create a testable, balanceable system, only as approved by the Engineer.
c. TAB Agency shall visit job prior to concealment of work, repeatedly if necessary due to construction scheduling, check work, and advise the Contractor and

Engineer on correctness of locations of dampers, access doors, test connections, etc., as well as any other special considerations affecting the TAB work. Advice shall be by letter, copied to both the Contractor and the Engineer within 3 days of the site visit but in any event before concealment.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. ASHRAE: American Society of Heating, Refrigerating, and Air-Conditioning Engineers

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TABB: Testing, Adjusting, and Balancing Bureau.

F. TAB Agency: An entity engaged to perform TAB Work.

1.4 SUBMITTALS, GENERAL

A. General: Submit all action submittals and informational submittals required by this Section concurrently, unless noted otherwise.

B. Contractor:

1. Prior to submittal of any equipment affecting TAB Agency, review with TAB Agency and obtain commentary and approval as described in “Summary” Article. Include TAB Agency review commentary with affected submittals.
2. Immediately upon approval of other submittals, provide the TAB Agency with copies of approved submittals, including Shop Drawings, of all hydronic and air systems and equipment requiring balancing.

1.5 ACTION SUBMITTALS

A. Contractor:

1. Perform no TAB work prior to TAB Agency approval. Within 30 days after award of Contract, submit TAB Agency qualifications proposal for approval:

   a. Name and contact information of proposed TAB Agency,
   b. Documentation that they meet the qualifications specified in "Quality Assurance" Article,
   c. Evidence of current TAB Agency and TAB Supervisor Certification,
   d. List of instruments to be used in testing and balancing, with current certification of all instruments’ calibration,

e. Examples of data forms proposed for each system type showing input cells for this Project's required data,
f. 3 regional references for comparable recent jobs.

B. TAB Agency:

1. Submit qualifications proposal as described above and in the "Quality Assurance" Article.

1.6 INFORMATIONAL SUBMITTAL

A. TAB Agency:

1. Instrument Calibration Reports: Include the following on calibration agency letterhead:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.
f. Range qualified.
g. Test data points – standards and measured values.
h. Acceptable and actual deviations from test values.

2. Contract Documents Examination Report: Within 15 days of Architect's approval of TAB Agency, submit the Contract Document Examination Report as specified in Part 3.
3. Strategies and Procedures Plan: Within 30 days of Architect's approval of TAB Agency, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
4. Include commentary with all Contractor submittals affecting TAB work as described above.
5. Pre-Construction Inspection and Testing Report: Prior to removal of any affected construction.
6. Preliminary Partial TAB Reports.

1.7 CLOSEOUT SUBMITTALS

A. Certified Final TAB Report.

1.8 QUALITY ASSURANCE

A. TAB Agency and Employee Qualifications

1. Any and all TAB Work shall be performed by direct employees of the TAB Agency, who are either TAB Field Supervisors themselves, or who are TAB Technicians working under the direct supervision of a full time onsite TAB Field Supervisor.

2. TAB Agency shall be a fully certified current member of "Associated Air Balance Council" (AABC), "National Environmental Balancing Bureau" (NEBB), or “Testing, Adjusting, and Balancing Bureau” (TABB). Agency shall be company specializing in the adjusting and balancing as specified in this Section of systems as specified and as shown on the Contract Documents, with documented experience as a fully certified member, and three current regional references for projects of comparable scope.
3. TAB Field Supervisor: Employee of the TAB Agency and currently certified by AABC, NEBB, or TABB as a Testing, Balancing and Adjusting Supervisor.
4. TAB Technician: Employee of the TAB Agency and currently certified by AABC, NEBB, or TABB as a TAB technician.

B. Conform to basic procedures and methods outlined by applicable publications in testing and balancing of air and water systems by the following organizations, and as modified by this document:

1. Associated Air Balance Council (AABC).
2. National Environmental Balancing Bureau (NEBB).
3. Testing, Adjusting, and Balancing Bureau (TABB).
4. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
5. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
6. Individual manufacturer requirements and recommendations.

C. TAB Conference: After approval of the TAB Strategies and Procedures Plan and before TAB Work begins, schedule and attend a meeting with Architect, Owner, and Construction Manager, at their convenience, to develop a mutual understanding of the details. Require the participation of the TAB Field Supervisor and Technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:

a. Review the Contract Documents examination report.
b. Review the TAB Strategies and Procedures Plan.
c. Review the System Readiness Report.
d. Coordination and cooperation of trades and subcontractors.
e. Coordination of documentation and communication flow.

D. TAB Report Data Forms: Follow AABC, NEBB, TABB, or SMACNA format as modified by the data requirements of this Project, subject to submittal approval.

E. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

F. Instrumentation Type, Quantity, Accuracy, and Calibration: Instruments as described in ASHRAE 111, Section 5, "Instrumentation.", all currently certified as calibrated by a NRTL or NVLAP in accordance with Division 01 Section “Quality Requirements”.

G. Contractor shall maintain qualified personnel at Project for system operation, trouble-shooting, making system changes, and performing mechanical adjustments in conjunction with TAB procedures.

1.9 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Environmental Requirements: Accomplish TAB work under appropriate outdoor temperature conditions.

C. Concealed Conditions: Before concealment of systems, verify and advise on type and location of balancing devices and test points. Make changes as required to balancing facilities.

1.10 COORDINATION AND SCHEDULING

A. Refer to Division 00 and Division 01 for overall project sequencing and scheduling requirements. Approvable balancing in accordance with the requirements of this section is required to be complete before Contract Substantial Completion. Assure that all HVAC work required to properly and completely test and balance the various systems, and all subsequent testing, balancing, and reporting on same, occurs in a timely fashion coordinated with the overall project schedule as required.

B. Testing, Adjusting, and Balancing of systems shall be accomplished as soon as the systems are complete enough to perform TAB Work. Multiple visits will be required for phased construction in cooperation with construction schedule, with multiple “pencil copy” submittals of partial TAB reports required promptly as each phase of TAB Work is accomplished. TAB Work and approval of at least partial pencil copy reports is required before Owner takes possession.

C. Contractor and TAB Agency shall return to the site approximately six months after initial testing and balancing is complete to perform system checkup and design condition rebalancing as defined below.

D. Contractor and TAB Agency shall be subject to recall to site to verify report information before acceptance of the report by the Architect.

E. Coordinate and schedule TAB work with Contractor, TAB Agency, Owner, Architect, and Construction Manager. Provide seven days' advance notice for each visit. Include scheduled test dates and times, and notify Architect in writing when TAB Work is scheduled to begin.

1. Obtain from Contractor 2 additional copies of Shop Drawings and other submittals for all equipment and systems to be tested and balanced as soon as possible but no later than 60 days prior to scheduled completion of equipment and systems installation.

2. Verify that Contractor has placed all systems and equipment in satisfactory operating condition as required allowing TAB Work to be properly performed.
3. Cooperate with Contractor and affected subcontractors as required to provide complete and proper testing, adjusting, and balancing of air and water systems.
4. Visit Project prior to concealment of Work and note location of dampers, test connections, and similar items. Record this information, transmit to Contractor, and incorporate on Record Drawings.
5. Coordinate timing of six month system check and design condition TAB Work with weather, Contractor, and Owner.

F. Phased Construction: Perform TAB Work during construction period, coordinated with Project phases as soon as systems are complete and before Owner takes possession. Perform balancing for record at final stage when all previously completed sub-systems are checked and re-balanced to design performance.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Provide tools, ladders, recording meters, gauges, thermometers, velometers, anemometers, Pitot tubes, inclined gauge manometers, magnehelic gauges, amprobes, voltmeters, psychrometers, tachometers, ultrasonic or other non-intrusive flowmeters, and all other instrumentation required to perform specified TAB work. Accurately calibrate all instruments.

1. Make instruments available to Architect to facilitate spot checks during testing.
2. Provide additional balancing devices as required.

PART 3 - EXECUTION

3.1 EXAMINATION

A. By TAB Agency:

1. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
2. Examine existing (before construction) and new systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, thermometers and gages, flow-control devices, balancing valves and fittings. Verify that locations of these balancing devices are accessible.
3. Examine the approved submittals for HVAC systems and equipment. Verify that proposed equipment can be balanced as specified and as required. Provide commentary on all submittals advising where additional balancing devices are needed or configuration adjustment is desired to facilitate TAB Work.

4. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
5. Examine test reports specified in individual system and equipment Sections.
6. Examine equipment performance data including pump curves.
    a. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

B. By Contractor:

1. Examine systems and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections has been performed, and all TAB preparation as described in “Preparation” Article is complete.

C. Both TAB Agency and Contractor:

1. Prepare and submit Systems Readiness Report itemizing any remaining deficiencies discovered and confirming all systems preparation has been properly performed.
2. Report any defects or deficiencies observed during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values. Include updates in partial TAB report submittals.
3. Promptly report abnormal conditions in mechanical systems or conditions that prevent system balance. If, for design reasons, system cannot be properly balanced, report as soon as observed.

3.2 PREPARATION

A. TAB Agency:

1. Prepare a TAB plan that includes site specific strategies and step-by-step procedures with this project’s equipment identified.

B. Contractor: Before commencing TAB work, and before new system startup, verify that systems are complete and in satisfactory operating condition. Ensure the following:

1. Equipment is operable, in a safe and normal condition, and is of the size and capacity specified in the Contract Documents, bearings are greased, belts are aligned and properly tight, and equipment with functioning controls is ready for operation. Required modifications to systems shall be made in advance of the TAB Agency’s arrival for that portion of the work.
2. Temperature control systems are operable to the extent required for TAB Work. Control valves must at least be installed complete and hand operable. Automatic dampers must be operable and under control. Safety interlocks and controls on HVAC equipment must be properly functional.
3. All motors, pumps, and fans have correct rotation.

4. Permanent electrical-power wiring is complete, and proper thermal overload protection is in place for all electrical equipment.
5. All ductwork, roof top units, grilles, registers, and diffusers are installed, complete, and cleaned of dust and debris.
6. All piping, terminal radiation, boilers, pumps, valves, required pressure taps, and hydronic specialties are correctly installed, complete, operational, and clean.

7. All ductwork, diffusers and registers have dampers where specified, and all hydronic systems have balancing and isolation valves where specified.
8. Duct system leakage has been tested where required and minimized.
9. Hydronic systems are flushed, vented, clean, leak free, and filled with specified heat transfer fluid.
10. System pump suction piping is properly vented to ensure absence of entrained air.
11. All dampers (fire, fire/smoke, register, grille, diffuser, automatic, and manual volume dampers) operate smoothly and are adjusted open.
12. All hydronic systems valves are installed with proper direction of flow and operate smoothly, balancing valves are adjusted open, two-way control valves are open, three-way valves are properly installed for their intended function of diverting or mixing fluid flows, and service valves are open or closed as required for normal flow.
13. Make preliminary adjustments to airflow patterns of all registers, grilles, and diffusers to obtain uniform space temperatures and air movement free from objectionable drafts and noise.
14. Clean new final design filters are installed everywhere called for.
15. Hydronic strainers are clean and any temporary screens are replaced with permanent screens. Sidestream filters have clean new filter bag installed and valves are closed.
16. Coil fins have been cleaned and combed straight.
17. Access doors in ducts are closed and duct end caps are in place.
18. Access doors necessary to reach duct volume dampers, balancing valves, and measuring stations are installed in accessible locations and are operable.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing", and in this Section.

1. Comply with requirements in ASHRAE 62.1, Section 7.2.2, "Air Balancing."

B. Contractor Assistance during TAB Work:

1. Maintain mechanically qualified personnel at Site to perform necessary mechanical modifications and adjustments in conjunction with TAB procedures.

a. Operate systems.
b. Provide trouble-shooting.
c. Change pulleys, sheaves, belts, etc., as required to meet system performance requirements.

d. Cut insulation, pipes, ducts, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures. Properly plug all holes. Provide new insulation that matches removed materials, finished in accordance with Division 23 Section "HVAC Insulation."
e. Adjust automatic damper linkages so they all operate smoothly and close tightly.
f. Perform necessary controls operations required for TAB procedures.
g. Re-adjust / make final adjustments to registers, grilles, and diffusers in cooperation with Owner and TAB Agency as required to obtain uniform space temperatures and air movement free from objectionable drafts and noise. As this affects system pressure drops, this must be completed before final airflow balancing.
h. Make any required additions or changes in types, locations, etc., of balancing equipment.
i. Provide other mechanical adjustments as required in conjunction with TAB procedures.

2. Leave system in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, restoring thermostats to specified settings, restoring systems to automatic operation as required, replacing ceiling tiles, cleaning, etc...

C. Mark equipment and balancing devices, valve position indicators, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
b. Measure static pressure directly at the fan outlet or through the flexible connection.
c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

    a. Report the cleanliness status of filters and the time static pressures are measured.

4. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
5. Obtain approval from Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

    a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.5 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.6 PROCEDURES FOR HYDRONIC SYSTEMS

A. Measure water flow at pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump at 60Hz/VSD bypass. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

   a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Architect and comply with requirements in Division 23 Section "Hydronic Pumps."

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved and mark pump manufacturer's head-capacity curve with this initial balance point. Note and record pump discharge valve position, then return to wide open (or maximum non-overloading position) for proportional balancing procedure.

   a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower at intended flow rate at run-out. Calculate the intended brake horsepower for the system based on pump manufacturer's performance

data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.

4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. With the system fully operational, all branch and terminal isolation, balancing, and control valves open, and the pump running at 60Hz/VSD bypass, measure the flow through all terminal units as well as the total system volume, without making any adjustments, and formulate a plan for preliminary balancing valve adjustment. Record and report all initial flow and pressure drop values.

D. Adjust all manual balancing valves to the proportionally correct gpm, not necessarily the design gpm.

1. If all the valves in a branch line's terminal units must be adjusted to limit gpm, then use the branch line manual balancing or isolation valve to limit the pressure drop across the terminal units in that branch so that at least one terminal unit's balancing valve remains wide open but still has the correct flow. Adjust all other branch lines to proper proportional gpm in this way, leaving the balancing valves in the flow limiting branches wide open.
2. Provide branch volume control by balancing valves only to the extent that the most open valve remains wide open and adjustments do not create objectionable hydronic sound levels. Under no circumstances shall total system volume be throttled back to design flow through the partial closing of all branch valves.
3. Record and report all initial adjustment positions and proportional flowrates achieved.

E. Vary total system flowrate by adjustments at pump.

1. For constant speed single pump operation systems: throttle the system pump balancing/triple-duty valve until the flow in the system is the design flow rate. If the available flow from the pump is less than the design flow using this procedure, report this to the engineer for advisement immediately. Report the pump, valve, and motor data both with the throttling valve in the wide open and at the final, design flowrate position.

2. For variable frequency drive pumps, Perform the following procedure for each pump circuit running individually:

a. Ramp the VSD to the minimum frequency required to obtain the design flow, with each pump discharge valve open to the maximum position consistent with accurate reading and VSD bypass/60Hz non-overloading operation.
b. Repeat this VSD adjustment for each pump circuit of lead / lag pumps driven by one VSD, and set the VSD at the higher of these two frequencies.
c. At this frequency (the full design frequency - could be more or less than 60Hz), adjust the higher flow rate circuit to the design flow rate by further throttling the pump balancing valve, so that the flow rate from each pump is identical at the design frequency.

d. Verify that all terminal units are at the design gpm to within the balancing tolerance, and if not, repeat steps above until design conditions are satisfied at all system valves, with no excessive pressure and resultant energy use.
e. Report this value as the design frequency in the balancing report, and in writing to the Contractor responsible for incorporation into controls work of the Division 23 .
f. Measure and report the flow-rate at 60Hz, and also at the frequency where the pump motor is running at full load amperage.
g. Measure and report all other pump flow data at this point.
h. Check settings and operation of each safety valve. Record settings.

3.7 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the automatic and manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.8 PROCEDURES FOR BOILERS

A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.9 PROCEDURE FOR MISCELLANEOUS DEVICE TESTING

A. Test and adjust all devices on project as required to correctly report the data listed below under paragraph on final report.

3.10 TOLERANCES

A. Adjust system totals to the sum of the connected load (plus leakage for air systems) rather than the scheduled pump or fan capacity.

B. Adjust air systems as follows:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.

2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Outside Air: Must at the minimum flow rate noted on plans or greater.

C. Adjust hydronic systems as follows:

1. Each pump to within 5 percent of the design flow values.
2. Branch lines and radiation to within 10 percent of the design flow values
3. A total maximum variation of 10 percent between terminal units designated as “typical of (#)”

3.11 PRELIMINARY REPORTING

A. Contract Document Examination Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for proper systems' balancing. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Pre-Construction Inspection and Testing Report: Prior to removal of any affected construction, prepare and submit report outlining results of Pre-Construction Inspection and Testing as outlined above and on the contract drawings.

C. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.12 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Heat Pump Unit Test Reports: For heat pump units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.

c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches, and bore.
i. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm .
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg .
f. Preheat-coil static-pressure differential in inches wg.
g. Cooling-coil static-pressure differential in inches wg.
h. Heating-coil static-pressure differential in inches wg .
i. Outdoor airflow in cfm.
j. Return airflow in cfm.
k. Outdoor-air damper position.
l. Return-air damper position.

F. Gas-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btu/h.
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.

k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg .
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.
h. Low-fire fuel input in Btu/h.
i. High-fire fuel input in Btu/h.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.
l. Operating set point in Btu/h.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm .

b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg .
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

I. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Air velocity in fpm.
c. Preliminary air flow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final air flow rate in cfm .
f. Final velocity in fpm.
g. Space temperature in deg F.

J. System-Coil Reports: For heat pump coils include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

K. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Design frequency for VSD pumps.
k. Impeller diameter in inches.
l. Motor make and frame size.
m. Motor horsepower and rpm.
n. Voltage at each connection.
o. Starter size, rating, heater data.
p. Amperage for each phase.
q. Rated efficiency, full-load amperage, and service factor.
r. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.

i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

L. Flow Measuring Station, Pump Discharge, and Balancing Valves:

1. Identification/station
2. Location
3. Size
4. Manufacturer
5. Model
6. Design flow rate
7. Design pressure drop
8. Actual/final pressure drop
9. Actual/final flow rate
10. Station calibrated setting

M. Automatic Balancing Valves Reports:

1. Identification/station
2. Location
3. Size
4. Manufacturer
5. Model
6. Design flow rate
7. Functional pressure drop range.
8. Actual/final pressure drop at system full flow condition.

N. Hydronic Control Valves Reports:

1. Location
2. Manufacturer
3. Model
4. Flowrate, specified and actual.
5. Pressure drop at full flow condition.

O. Gauges and Thermometers Reports:

1. Identification/number
2. Location
3. Service
4. Manufacturer
5. Test all gauges and thermometers for mid range accuracy. Adjust thermometers where applicable; adjust all gauges for best 0 and/or midrange accuracy.
6. Temperature, test reading and actual
7. Pressure, test reading and actual

P. Controls Sensors Reports:

1. Coordinate work with Energy Management and Control System.
2. Test all controls system temperature, pressure, and electrical current analog sensors for mid normal operating range accuracy. Adjust where applicable.
3. Test all controls system temperature, pressure, and electrical current digital (on/off) sensors/switches for trip point. Adjust where applicable.
4. Verify that locations shown on Operators Work Station are schematically correct.
5. Identification/number
6. Location
7. Service
8. Manufacturer
9. Temperature, test reading and actual
10. Pressure, test reading and actual

Q. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.13 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.

2. Check the following for each system:

a. Measure water flow of each device.
b. Verify that balancing devices are marked with final balance position.
c. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made.
2. The TAB Agency’s test and balance engineer shall conduct the inspection in the presence of Commissioning Authority.
3. Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total

measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB agency to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB Agency's final payment.

D. Prepare test and inspection reports.

3.14 ADDITIONAL TESTS

A. Re-check and adjust systems approximately 6 months after final acceptance and submit report:

1. Measure the total flow rate of each of the systems originally covered by this section.
2. For each of the systems that no longer operate at design flow measure the flow at each of the terminals of that system.
3. Measure the flow at any terminals included in the original balancing, reported by the Owner or Architect to have continued or new problems.
4. Adjust system changes back to the design values if possible, and submit reports in writing to the Architect, Contractor, and Owner, noting any changes and/or complaints, and offering an interpretation of the cause and significance of the problems.

5. If the design air temperature criteria as specified cannot be satisfied upon initial balancing, perform this six month stability check at a time when it can be, and repeat water system balancing performance testing using air temperature at the design conditions.

END OF SECTION 23 05 93

SECTION 23 07 00 - HVAC INSULATION

1. PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including general and supplementary conditions and Division 01 specification sections, apply to this section.

1.2 SUMMARY

A. Section includes insulation and related materials and installation requirements for mechanical component insulation.

1. Provide thermal and acoustical insulation for components shown on the Drawings as specified in this Section for the following:

   a. All heating and air conditioning systems piping including fittings, valves, and accessories.

   b. All heating and air conditioning ductwork unless noted otherwise.

      1) All heating and air conditioning ductwork labeled as exposed shall not be insulated unless noted otherwise.
      2) All heating and air conditioning ductwork within a Mechanical Room, Boiler Room, Fan Room, etc., shall be insulated whether exposed or not.

   c. All outside air ductwork extending from exterior wall or roof to the equipment which it serves.
   d. Exhaust, return, and relief air ductwork for air to air energy recovery devices.
   e. Exhaust, return, and relief air ductwork that does pass through air to air energy recovery devices prior to exiting the system: insulate complete as described below.
   f. Single wall boiler breeching, with high temperature type insulation.
   g. Air separators, heat exchangers, tanks, and all other HVAC components that operate more than 15 degrees F above or below ambient conditions.
   h. All cooling condensate drain lines.
   i. Condenser Water Piping

1.3 DEFINITIONS

A. “Concealed”: Work within or behind various construction elements, or in crawl spaces or trenches, that is not exposed to view when Project has been completed. (Areas above ceilings, including above Auditorium or Large Group Instruction partially open “cloud” ceilings and chases are considered a concealed location.)

B. "Exposed": Anything exposed to view when project has been completed.

1.4 SUBMITTALS

A. Comply with requirements of SECTION 013000 - Submittals and as modified below.

B. Product Data

1. Submit complete manufacturer's product information for each type of insulation specified in this section demonstrating compliance with specified requirements and including:

   a. Thermal performance.
   b. MSDS information.
   c. Fire and flame spread data.
   d. Installation methods and recommendations.

2. Submit complete manufacturer's product information for each type of insulation and wrapping specified in this Section demonstrating compliance with specified requirements.
3. Submit schedule of types of insulation indicating service where each type and thickness is applied and including fitting covering methods and applicable coverings and finishes.

C. Quality Control Submittals

1. Qualifications Certification: Submit written certification or similar documentation signed by Contractor and manufacturer (where applicable) indicating compliance with applicable "Qualifications" requirements specified below in "Quality Assurance" article.
2. Installer Experience Listing: Submit list of completed projects using products proposed for this Project, including Owner contact information for each project, demonstrating compliance with applicable "Qualifications" requirements specified below in "Quality Assurance" article.

D. Contract Closeout Submittals: Comply with requirements of SECTION 017000, including submission of maintenance instructions as item in "Operating and Maintenance Data" manual described in that section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Insulation systems shall be installed by certified contractor having a minimum of 5 years documented experience in the installation of insulation systems described herein. Installers shall be skilled mechanics who have successfully completed an apprenticeship program by the Department of Labor, Bureau of Apprenticeship and Training, ASHRAE / NIA 8 hour *Mechanical Insulation Training* course or equal, and are certified as trained installers of the proposed insulation materials by the manufacturers of each product proposed.

B. Condensation Resistance: Provide insulation and vapor barrier systems complete as required to eliminate condensation under any normal operating conditions from surfaces of all cooling equipment and components provided or modified as a part of this contract Work, unless those

surfaces are designed to remove moisture by condensation from process air, and to contain and drain the condensate.

C. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

D. Mockups: Before installing insulation in general, install example mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Install mockups in the location indicated or, if not indicated, in general in conveniently accessed locations in mechanical spaces where insulation will remain exposed for continued review. Coordinate specific locations with CM and Architect. Use materials indicated for the completed Work.

1. Piping Mockups:

a. One 10-foot section of NPS 2 straight pipe.
b. One each of a 90-degree threaded, welded, and flanged elbow.
c. One each of a threaded, welded, and flanged tee fitting.
d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
e. Four support hangers including hanger shield and insert.
f. One threaded strainer and one flanged strainer with removable portion of insulation.
g. One threaded reducer and one welded reducer.
h. One pressure temperature tap.
i. One mechanical coupling.

2. Ductwork Mockups:

a. One 10-foot section each of rectangular and round straight duct.
b. One each of a 90-degree mitered round and rectangular elbow, and one each of a 90-degree radius round and rectangular elbow.
c. One rectangular branch takeoff and one round branch takeoff from a rectangular duct. One round tee fitting.
d. One rectangular and round transition fitting.
e. Four support hangers for round and rectangular ductwork.

3. Equipment Mockups:

a. One each base mounted and in-line heating-hot-water pump.

b. One tank or vessel.

4. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, jackets, and all other associated components. Provide labeling of all components as required to allow identification by observers.
5. Notify Architect seven days in advance of dates and times when mockups will be constructed.
6. Obtain Architect's approval of mockups before starting insulation application.
7. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
8. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
9. Remove labeling and cutaway sections of mockups when directed, and complete insulation per specifications and as required integrating with balance of job.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. For convenience, details and specifications have been based on products by the following manufacturers:

1. Armstrong; Lancaster, Pennsylvania
2. Benjamin Foster
3. CertainTeed; Valley Forge, Pennsylvania
4. Johns Manville; Defiance, Ohio
5. Kingspan Tarec
6. Knauf; North Carolina
7. Owens-Corning; Toledo, Ohio
8. Or Approved Equal.

2.2 MATERIALS

A. Pipe and Fitting Insulation: Provide pipe insulation in compliance with ASTM C 585 Dimensional Standards.

1. Interior Above Grade Piping:

a. Piping Insulation: ASTM C547, cylindrically molded preformed rigid half pipe shell forms, factory one-piece “hinged” construction.

1) Rigid pipe or tube insulation may be of mineral wool, fiberglass, closed cell glass, formed polyisocyanurate, formed phenolic, or extruded polystyrene (chilled service only).
2) Thermal Conductivity (“k”): To use specified thicknesses below, insulation conductivity shall be no greater than 0.27 BTU - in /(hr-sq.ft. -deg. F) at 75 deg. F mean temperature when measured in accordance with ASTM C 335. Adjust thickness in accordance with below formula.
3) Jacket: ASTM C 1136, white Kraft outer surface bonded to aluminum foil and reinforced with fiberglass yarn, permanently treated for fire and smoke safety and to prevent corrosion of foil with self-sealing pressure sensitive lap; similar to “AP-T Plus Jacket” by Johns Manville.

a) Water Vapor Permeance: ASTM E96, Procedure A, 0.02 perm maximum.

2. Make-up water and Condensate Drain Lines: insulation material similar to rigid pipe or refrigerant piping insulation specified above.

3. Fitting and Valve Insulation: Precut fiberglass blanket to match thickness, appearance and efficiency of adjacent pipe insulation; similar to “Hi-Lo Temp Fiber Glass Insulation Insert” by Johns Manville.

4. Insulation Thickness:

   a. Pipe and fitting insulation thicknesses specified assume an insulation conductivity (k) value of 0.27 btu•in/hr•ft2•ºF. For pipe and fitting insulation with conductivity other than 0.27 btu•in/hr•ft2•ºF, insulation must be thicker for higher conductivity and may be thinner for lower conductivity as required to achieve same or higher R value. Adjust insulation thickness from that specified in accordance with the following formula:

      T = r[(1+t/r)K/k-1] where:

      1) T = Adjusted insulation thickness, inches
      2) r = Actual pipe outside radius, inches.
      3) t = Insulation thickness specified, inches.
      4) K = actual insulation conductivity, btu•in/hr•ft2•ºF.
      5) k = specified conductivity, 0.27 btu•in/hr•ft2•ºF.

   b. Hydronic Piping for Heating and / or Cooling (Condenser Water):

      1) Pipe sizes ½ inch through 1-½ inches ..... 1-1/2 inch
      2) Pipe sizes 2 inches and larger ..... 2 inches

   c. Make-Up Water and Condensate Drain Piping

      1) All pipe sizes..... ½ inch

   e. Flexible Connections:

      1) Pipe sizes ½ inch through 1-½ inches ..... 1/2 inch
      2) Pipe sizes 2 inches and larger ..... 1 inch

B. Pipe Fitting and Valve Covers, and Piping Protective Jackets:

1. All Purpose (AP) vapor barrier jacket for pipe insulation: White kraft paper outer surface bonded to aluminum foil and reinforced with fiberglass yarn, permanently treated for fire and smoke safety and to prevent corrosion of foil.

   a. Water Vapor Permeance: ASTM E96, Procedure A, 0.02 perm maximum.
   b. Puncture resistance: ASTM D781, 85 scale units minimum
   c. Burst resistance: ASTM D774, 100psi minimum.
   d. Similar to “150TL facing” as used in “AP-T Plus Jacket” and tape by Johns Manville, or equal.

2. Interior Pipe Insulation Protective Jacket:

a. Plastic: High-impact, UV resistant polyvinyl chloride, white, paintable, covering designed to fit over AP jacketed insulated piping systems, molded to fit various sizes of fittings, valves, and piping as required; similar to "Zeston 2000 or Zeston 300 PVC Jacketing" by Johns Manville.

1) 20 mil thickness: Fittings and valves in interior applications eight feet above finished floor and higher.
2) 30 mil thickness: Fittings, valves, and straight pipe in interior applications lower than eight feet above finished floor.

b. Aluminum: Circumferentially corrugated 20mil thick or embossed 24 mil thick, with approved moisture barrier, with matching preformed fitting covers by same manufacturer. Similar to Corrolon by Childers.

3. Exterior Pipe Insulation Protective Jacket: Modified bituminous, aluminum skinned, peal and stick membrane, similar to Polyguard "Alumaguard 60", with the following properties:

a. Minimum 60 mils thick
b. Permeance less than 0.01 Perms
c. Puncture resistance per ASTM E154 >40lbs.
d. Overlap bond peal adhesion per ASTM D1000 never less than 11lb/in.
e. UV stabilized.
f. Self-healing when punctured.

C. Duct Insulation

1. Rigid Board: 3 PCF minimum density glass fiber board (6PCF when exposed in mechanical or utility spaces) or phenolic, with factory-applied AP vapor barrier; similar to "800 series Spin-Glas" and "AP" facing by Johns Manville, or Kingspan KoolDuct.

2. Semi-Flexible: 2.5 PCF minimum density continuous glass fiber oriented strand sheets, with factory-applied AP vapor barrier. Strand orientation such that material has comparable rigidity to board type insulation above in one direction and comparable compressive strength, but is flexible enough in the other direction to wrap curved surfaces at a factory recommended minimum bend radius of 3T where T is the material thickness. Similar to "CrimpWrap" by CertainTeed.

3. Flexible: Glass fiber blanket, 3/4 PCF minimum density, with factory-applied, flame-resistant, FSK jacket; all joints taped; similar to Owens Corning "Fiberglas All Service Duct Wrap".

4. Acoustical / Thermal Duct Lining: 1-inch thick minimum or as otherwise noted, glass fiberboard. Fibers bonded with thermosetting resin, surface exposed to air stream and factory edges bonded then coated with a fire, bacterial, fungal and abrasion resistant coating; rated for velocities up to 4000 fpm and temperatures to 250 degrees F. Similar to Owens Corning "Fiberglass Duct Liner Board".

a. Where used in lieu of other thermal insulation, provide with rated R-value of at least that specified below. Increase sheet metal size as required to provide free area shown on drawings

5. High-Temperature Duct Insulation: Non-combustible glass fiber insulating wool, 2.4 PCF minimum density, bonded with thermosetting resin, suitable for temperatures up to 1000 deg. F minimum. Similar to Owens Corning "TIW Type II"

   a. Thickness: 1 inch and 2 inches as specified in Part 3 below.

6. Fire Rated Duct Insulation: U.L. 1978 listed, complying with requirements of ASTM E2336-04 for use in fire rated duct and grease duct assembly. Long ceramic or mineral fiber blanket, 6 PCF minimum density, 1-1/2 inch thickness unless otherwise specified. Cover with foil-faced scrim jacketing. Include all metal banding, collars, straps and U.L. listed tape and other accessories to make a complete listed assembly.

D. Ductwork Insulation Protective Jackets:

1. All Purpose (AP) Vapor Barrier for Duct Insulation: White kraft paper outer surface bonded to aluminum foil and reinforced with fiberglass yarn, permanently treated for fire and smoke safety and to prevent corrosion of foil.

   a. Water Vapor Permeance: ASTM E96, Procedure A, 0.02 perm maximum.
   b. Puncture resistance: ASTM D781, 85 scale units minimum
   c. Burst resistance: ASTM D774, 100psi minimum.
   d. Similar to "150TL facing" as used in "AP-T Plus Jacket" and tape by Johns Manville, or equal.

2. Foil-Skrim-Kraft (FSK) Vapor Barrier for Duct Insulation: Foil faced outer surface bonded to kraft paper backing and reinforced with fiberglass yarn, permanently treated for fire and smoke safety and to prevent corrosion of foil.

   a. Water Vapor Permeance: ASTM E96, Procedure A, 0.02 perm maximum.
   b. Similar to "FSK Jacket" and tape by Johns Manville, or equal.

E. Mechanical Equipment Insulation:

1. Heating Equipment (Pumps, Suction Diffusers, Heat Exchangers, Tanks, Air Separators, etc.):

   a. Insulation: Same as rigid board and semi-flexible duct insulation described above, in 6pcf density.
   b. Prefabricate assemblies so as to be easily removable in assembled sections for service.

2. Cooling Equipment (Cold Service Pump Volutes, Air Separators, Tanks, etc):

a. Insulation: 1-1/2 inch thick (2-inches thick for exterior applications), fire-resistant, closed cell flexible (elastomeric) foam plastic, similar to Armacell "Armatuf White". May be multiple thicknesses (inner layers may be similar material without facing similar to "Armaflex AP") with offset joints for complex tight curved shapes or single thickness. Provide sheet stock with either PSA or plain backing, with manufacturer's recommended adhesive for all joints and backing, manufacturer's matching protective vapor barrier facing tape, and Corrosion Inhibitor equal to "Polyguard RG-2400".

F. Insulation Accessories:

1. Mechanical Pin Fasteners: Provide welded pins or perforated back (minimum $4in^2$ surface area) glued pins with push washers, bonded with full coverage of manufacturer's recommended adhesive. Choose pin length based on manufacturer's recommendations for insulation density and thickness so as to securely hold insulation with manufacturer's recommended compression.

   a. Not permitted: PSA backed "peal and stick" pins, wrapping or securing with wires, sheet metal fastening screws, or any other penetration of duct by fasteners.

2. Insulation Securement Bands: For larger cylindrical surfaces, tension securement bands may be used to supplement or replace mechanical pin fasteners. Provide bands of material compatible with insulation and system being insulated, minimum ½ inch wide and as required to avoid compressing insulation at required securement tension (3/4 inch minimum for diameters over 36 inches), 24 gage thick or thicker. End buckles of similar material.

3. Insulation Covering Canvas: 8 oz., 100 percent cotton, with flame spread 10 and smoke developed 0 ratings; similar to "Thermocanvas" by Fattal, Chicago, Illinois.

4. Pumps, Suction Diffusers, Heat Exchanger Frames and Heads, Triple Duty Valves, Balancing and Control Valves over 2" nominal size, and other HVAC components needing periodic maintenance or adjustment:

   a. Fabricate two piece removable metal boxes lined with insulation of thickness as specified.
   b. Sheet metal box construction in accordance with section 23 31 00 – Air Ducts and as follows.
   c. Materials shall be G-90 galvaneal, painted to match surrounding insulation system color.
   d. Secure enclosure to equipment with repeatedly re-usable bolts, clips, or bands that do not require tools for service access or additional tape for re-assembly.
   e. Fabricate joints with hemmed edges, outward bolted flanges or secure latching mechanism. Bolt flanges on 6-inch centers, starting at corners, using 3/8-inch-diameter fasteners with wing nuts.
   f. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

5. Insulation Tapes: Provide insulation manufacturers' recommended and matching tapes, matching characteristics of exterior jacket of insulation, in widths as required and as specified below to seal all gaps and reinforce vulnerable areas in vapor barrier. Provide tapes with peel off protective coating covering high performance acrylic adhesive unless manufacturer documents superior performance of alternative recommendation.
6. Insulation Adhesives and Mastics: Provide insulation manufacturers' recommended and matching adhesives and mastics, as required and as specified below to seal all gaps and reinforce vulnerable areas in vapor barrier. Provide with water based and low VOC formulations unless manufacturer documents superior performance of alternative recommendation and performance deficiencies of water based low VOC products.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Verify that systems and equipment to be insulated have been tested and are free of defects.

C. Verify that surfaces to be insulated are clean and dry.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Beginning installation constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion inhibition coating to surfaces to be insulated as follows:

1. All non-galvanized ferrous components with a service temperature below ambient (chilled water and chilled water/glycol systems): Coat with one full coverage coat of specified corrosion inhibition coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 INSTALLATION

A. General:

1. Comply with manufacturer's installation instructions and recommendations.
2. Do not begin mechanical insulation until permission is granted to begin mechanical insulation installation, hydronic systems have proved drip free under pressure, duct systems have passed required duct leakage requirements and testing, indoor work areas are weather tight, and outdoor work areas are at appropriate ambient conditions.
3. Below ambient temperature applications:

   a. Provide corrosion inhibition coating as specified above.
   b. Apply vapor barrier mastic and sealant to all open ends, joints, seams, breaks, and punctures in insulation.

4. Do not use any insulation support system which causes compression of insulation, localized or widespread, to less than 75% of the rated nominal thickness. Wires wrapped around rectangular duct insulation are not permitted as insulation support.

5. Provide for durable and repeated service access as part of insulation system.

   a. Do not permanently cover inspection stampings, hand holes, manholes, plugged outlets, or similar features on equipment – provide removable labeled insulated access port with beveled and sealed insulation plug, gasketed if vapor barrier is needed, durably fabricated for repeated access.
   b. Provide removable insulated boxes as specified for Pumps, Suction Diffusers, Heat Exchanger Frames and Heads, Triple Duty, Balancing, and Control valves, and other HVAC components needing periodic maintenance or adjustment.

6. Install thermal mechanical insulation as follows:

   a. Only on clean, dry surfaces and after piping and ductwork has been tested and found to be tight.
   b. Continuously through wall or ceiling openings and sleeves.
   c. On cold surfaces with continuous unbroken vapor seal.
   d. Insulate ducts and pipes individually.

7. Where more than one layer of insulation is required to achieve specified thickness or R value, apply thinner layer first, and stagger joints between insulation layers at least 3 inches.

B. Pipe Insulation

1. Comply with manufacturer's installation instructions and recommendations. Install only when ambient temperatures are within range recommended by manufacturer. STAPLES NOT PERMITTED.
2. Provide high impact plastic wrapper on all exposed, insulated piping from finished floor to 8 ft. above finished floor.
3. Interior Pipe and Fitting Insulation: Install on all heating, Condenser, and condensate piping. Seal with factory applied pressure-sealing adhesive strip on the longitudinal lap. Seal butt joints with pressure-sealing adhesive strip at least 2 inches wide. Install valve and fitting covers in all locations.
4. Insulation at Pipe Support: Refer to SECTION 23 05 29 - Hangers and Supports for material specifications of insulated piping support assembly and pipe support insulation. Complete insulation installation for the applicable pipe support insulation type to be used.

    a. Type “B” Pipe Support Insulation:

        1) Install pipe support insulation at hanger and support locations in conformance with manufacturer’s recommendations and as indicated on Drawings.
        2) Remove a section of insulation from pipe insulation and replace this section with heavy density molded fiberglass blocks without breaking vapor barrier wrap.

    b. Type “C” Pipe Support Insulation:

        1) Provide butt connection to high-density insulation sections at pipe hangers as specified in Section 23 05 29 - Hangers and Supports.
        2) Provide insulation with vapor barrier on upper half of insulated piping support assembly.
        3) Apply wet coat of vapor barrier lap cement on butt joints and finish coat of vapor barrier mastic.
        4) Tape edge of insulation section edge and insulation with white, pressure-sensitive PVC tape with tape extending over adjacent pipe insulation by at least 2 inches.

C. Ductwork Insulation: Provide external thermal insulation on ducts as specified or indicated on Drawings; external thermal insulation not required where ducts are shown or specified with internal acoustical insulation. Insulate and seal around duct dampers, damper motors, thermometers, instruments, access doors, and similar component as required without restricting operation or function. Insulate all ducts in all concealed spaces.

1. Provide insulation thickness on ducts, plenums, and equipment equal to height of flanges, but not less than thickness required to achieve duct insulation R values specified herein:

    a. R=15 deg. F-sq. ft.-h/Btu-in:

        1) Exterior Duct with any transverse dimension above 48 inches (R=15 minimum, not average)

    b. R=10 deg. F-sq. ft.-h/Btu-in:

1) Exterior Duct with no transverse dimension above 48 inches (R=10 minimum, not average)

c. R=8 deg. F-sq. ft.-h/Btu-in

1) Outside air intake duct

d. R=5 deg. F-sq. ft.-h/Btu-in:

1) All other interior HVAC duct where insulation is required, unless otherwise noted elsewhere.

e. Insulate to Special R values, as specifically noted elsewhere:

1) Boiler breeching, high temperature duct, fire rated duct

2. Use flexible type insulation on concealed ductwork with widths or diameters of 18 inches or less only. Insulate all other ductwork requiring insulation with rigid board type, semi-flexible type, or other type as required by drawings.
3. Duct Insulation Mechanical Fasteners: Provide mechanical fasteners for all duct surfaces over 12” wide. For duct surfaces 18’” wide and less, provide single row of fasteners down duct centerline. For duct surfaces over 18” wide, install minimum of 2 rows per side, applied on maximum 18" centers, starting within 3" of any edge.

a. Adhered pins with the point facing out: clip points close to washers and cover with vapor barrier adhesive and tape. Not permitted on mechanical room duct unless covered by puncture resistant protective wrapper.

4. Duct Insulation Tape: Apply only to clean dry dust free surfaces as recommended by tape manufacturer and as required for durable adhesion.

a. Pealing tape, loose insulation, or otherwise broken vapor barrier subject to repeated recall.

5. Rigid Board Type Insulation Installation: Install board with all corners mitered or rabetted; no butt joints allowed. Secure insulation with mechanical fasteners. Apply corner reinforcement angles (beads) on all corners for exposed ductwork (including in mechanical or storage spaces), with edge tape over beads. Seal all breaks and joints in vapor barrier with 3 to 5 inches wide insulation tape (minimum 1.5” tape past break all around).
6. Semi-flexible Type: Install similar to rigid board type, on round duct, curved elbows, etc.. Wrap curved and round surfaces taught, provide circumference tape band maximum two feet on center (butt joints and center of four foot roll stock).
7. Flexible Type Insulation Installation: Make all joints and seams with 2-inch lap of vapor barrier cemented with Benjamin Foster “BF85-20”. Apply Benjamin Foster “BF-20” adhesive to ducts in 6-inch brush widths at 1 ft. intervals and at each facing edge. Tape all adhered with Benjamin Foster “BF-20”. Tape seal all seams, breaks, and joints in vapor

barrier, then continuously coat all tape with manufacturer's recommended vapor barrier adhesive

8. Acoustical Duct Lining: Install on low velocity ductwork as noted on Drawings, adhering to sheet metal duct with 100 percent coverage of adhesive meeting the requirements of ASTM C 916, and additionally securing with mechanical fasteners as noted above but on 12-inch centers maximum in the transverse direction. Seal all edges, transverse joints and fastener penetrations with adhesive. Protect all exposed edges with metal nosing causing no greater than 10% compression of the liner.
9. High Temperature Mechanical Insulation: Install all materials in strict compliance with manufacturer's printed instructions and recommendations where indicated on Drawings or recommended by manufacturer of specific equipment.

    a. Install by attaching with welded pins or studs, spaced not more than 16 inches on center and not more than 4 inches from edge of insulation. Install 1-inch thick material first followed by 2-inch thick material. Offset all joints.
    b. Cover with metal mesh and insulating cement. Recover with 7 oz. canvas, smoothly applied, adhered and sized with Benjamin Foster "BF-30" adhesive.

10. Fire Rated Duct Insulation: Install, precisely following manufacturer's instructions, as required to achieve U.L. Listed fire rated assembly of the rating required by the application.

11. Duct Insulation Schedule

    a. Ductwork in Mechanical Rooms: Rigid.

    b. Internally line first ten (10) feet of supply ductwork with Acoustic Lining sandwiched between an inner perforated metal liner.

D. Equipment, Tank, and Vessel Insulation Installation

1. Thickness of insulation:

    a. Pumps, air separators, suction diffusers: 2 inches (R=8 minimum).
    b. Storage tanks, heat exchangers: 3.5 inches (R=12.5 minimum).
    c. Air Conditioning Service Diffusers: ½ inch (R=2 minimum)

2. Insulation Installation for Tanks and Vessels:

    a. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
    b. Develop three dimensional curves using cuts and curves, not wrinkles. Miter exterior corners and provide corner reinforcement angles. Do not use mastic or joint sealer as filler for gaps and voids resulting from poor workmanship: re-cut new better fitting pieces with adjacent insulation sections touching.
    c. Protect exposed corners with secured corner angles.

d. Secure insulation with adhesive, anchor pins and washers, and securement bands as required.

e. Apply adhesives as follows:

1) Select insulation adhesive compatible with service temperature, substrate, and insulation.
2) Provide 100 percent coverage of tank and vessel surfaces.
3) Follow manufacturers' recommended coverage rates per unit area.

f. Install Mechanical Pin Fasteners on sides of tanks and vessels as follows:

1) Do not weld anchor pins to ASME-labeled pressure vessels.

2) Select insulation hangers and adhesive compatible with service temperature and substrate.
3) Maximum pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
4) Impale insulation over anchor pins and attach speed washers.
5) In concealed applications, cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. In exposed mechanical room applications, bend excess portion of pins extending beyond speed washers parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

g. Provide securement Bands as follows:

1) Use where adhesives and mechanical pin fasteners are inappropriate or inadequate as required to secure insulation.
2) Secure each layer of insulation with securement bands seperately.
3) Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.

3. Pumps, Suction Diffusers, Heat Exchanger Frames and Heads, Triple Duty Valves, Balancing and Control Valves over 2" nominal size, and other HVAC components needing periodic maintenance or adjustment:

a. Provide painted sheet metal removable cover as specified above.

b. Fit boxes closely to component being insulated and adjacent system insulation and coincide box joints with component and adjacent equipment installations so as to be easily removable for service access to all parts requiring service.
c. Valves with insulated non-condensing stem assembly: insulate and seal to stem, leaving insulated adjustable portion of valve\s exposed.

4. Surface Finish of Equipment Insulation:

a. Heating Equipment with no serviceable parts concealed: Reinforce insulation and cover with metal mesh and insulating cement. Recover with 8 oz. canvas, smoothly applied, adhered and sized with Benjamin Foster “BF-30" adhesive.
b. Cooling Equipment with no serviceable parts concealed: Glue all joints with 100% adhesive coverage of cut surfaces. Seal assembly vapor tight as required to avoid condensation. Paint all exposed insulation edges with manufacturers (white) finish, similar to “WB Armaflex” or equal, and cover all joints with manufacturer’s matching protective vapor barrier facing tape.

END OF SECTION 23 07 00

SECTION 23 08 00 – COMMISSIONING PLAN – C0NSTRUCTION PHASE (ALTERNATE NO. 6)

PART 1 - OVERVIEW

1.1 ABBREVIATIONS AND DEFINITIONS

A. The following are common abbreviations used in this document. Definitions are found in Commissioning Section of the Specifications.

A/E-	Architect and Design Engineers	FT-	Functional performance test
ICA-	Independent Commissioning authority	GC-	General Contractor
CC-	Controls Contractor	MC-	Mechanical Contractor
OR	Owner's Representative	PC-	Prefunctional checklist
Cx-	Commissioning	PM-	Project Manager
Cx Plan-	Commissioning Plan document	Subs-	Subcontractors to General
EC-	Electrical Contractor	TAB-	Test and Balance Contractor
CM-	Construction Manager	SMC	Sheet Metal Contractor

1.2 PURPOSE OF THE COMMISSIONING PLAN

The purpose of the construction phase commissioning plan is to:

A. Provide direction by the Cx Plan as specified by A/E during the construction and revision of the Renovation and Addition at the Office of the President on the DTCC Terry Campus.

B. Provide direction for the commissioning process during the construction, particularly facilitating resolution for issues and providing details for the commissioning process. To provide CX scheduling, participation of various parties of this particular project, actual lines of reporting and approvals, coordination, etc.

This plan does not provide a detailed explanation of required testing procedures. The detailed testing requirements and procedures are found in the various Specifications Sections or on manufacturer's start-up procedures. Additionally, this plan does not provide extensive narrative on all commissioning concepts, as may be provided in other commissioning guides.

1.3 COMMISSIONING SCOPE

A. Commissioning is a systematic process of ensuring that all building systems being commissioned perform interactively according to the design intent and the Owner's operational needs. This is normally achieved by beginning in the design phase, documenting the design intent and continuing through construction, acceptance and the warranty period with actual verification of performance, as is this case.

B. Commissioning during the construction of this project is intended to achieve the following specific objectives:

According to the Contract Documents:

- Ensure that applicable equipment and systems are installed properly and receive adequate operational checkout by installing contractors in accordance with the contract documents and manufacturer's instructions.

- Verify and document proper performance of equipment, systems and controls, and carry out readiness checks and document results. Ensure control checks are completed and documented.
- Ensure that O&M documentation left on site is complete.
- Ensure that the Owner's operating personnel are adequately trained.
- Oversite and reviewing of TAB activities and results to confirm TAB operation will be completed prior to the commissioning of systems.
- With the OR, CM, and G.C., coordinate commissioning activities among contractor's sub and other trades.
- ICA to observe all final startup, system operations, and functional test, and all equipment/systems for performance verification purposes.

1.4 COMMISSIONED SYSTEMS [BID DOCS]

A. The following marked systems will be commissioned in this project. In Phase I, system readiness and startup. All general references to equipment in this document refer only to equipment that is to be commissioned.

HVAC System

_X_ ATC System
_X_ Ductwork, Accessories, Hangers & Insulation
_X_ Ductless Split A/C System ACU-1 & RCU-1
_X_ Exhaust Fans
_X_ TAB
_X_ HVAC Insulation
_X_ Grills, Registers, Diffusers, & Louvers
_X_ Water Source Heat Pumps
_X_ Terminal Heating Equipment
_X_ Variable Frequency Drives – Pumps P-1 & 2
_X_ Hydronic Piping, Pumps & Hangers, Insulation, Expansion Tanks, Air Separator, etc., P-1 & 2
_X_ Geothermal Well Field
_X_ Geothermal Heat Pumps
_X_ Boiler B-1
____ VAV Boxes VAV-1 – 6
____ Fire Dampers
____ Rooftop Unit RTU-1

Plumbing Systems

____ Electric Water Heater & Pipe Insulation
____ Plumbing Fixtures
____ Rain Water Harvesting System & Booster Pumps

Electrical

____ Fire Alarm
____ Lighting controls

____ Electric Feed & Distribution Testing Review & Underwriter's Report
____ Photo Voltaic System
____ Wind Turbine System

1.5 COMMISSIONING PROCESS & FORMS

A. The commissioning of a project is a process which will be tracked and scheduled using the following:

- The Commissioning Agent will compile a record notebook for this project containing tabs:
  - Correspondence
  - Construction Commissioning Plan
  - Commissioning Schedule
  - Meeting Minutes and Progress Reports
  - Progress Record
  - Issue Log – by e-mail to OR.
  - Prefunctional Testing (Systems Readiness, Startup & Initial Operation)

    This includes all items listed in 1.4 above with separate tabs for major areas. (Mechanical)
  - Functional Performance testing.

    This includes all systems noted in 1.4 above, both tested as operating system in normal, and fire alarm with separate tabs.
  - Demonstration, Training, Record Plans and Maintenance Manuals

- A series of forms will be used to initiate, track and show resolution on the non-compliance with the commissioning process. The forms will include, but not be limited to:
  - Cx issues log
  - Request for documentation and record of submission
  - Cx test or review approval.
  - Testing scope outline
  - Overall staff training and orientation

2. GENERAL BUILDING INFORMATION (BID)

Project: Delaware Tech & Community College Addition & Renovations to the Office of the President

Location: Terry Campus, Dover, Delaware 19904

Building Type (Office, Court, Etc.): Administrative

Square Footage: 14,900 +/- Number of Stories: 1

Agency: Owner Tenants: Owner

Construction Period: To be determined

Commissioning of the Mechanical Renovations, and new construction, and confirm interconnection with fire alarm. The installation of a new Water Source Heat Pump, HVAC System, with a boiler, pumps, heat pumps, and exhaust systems. New ATC System, with balanced air and water flow, and water/air distribution, and pumps with VFD's. Plumbing will be limited, and not to be commissioned.

____ TAB
____ Grills, Registers, Diffusers
____ Hydronic Piping/Pumps/Leak Testing/Boiler/Air Separator/Expansion Tanks
____ Fan Coil Unit's FCU's
____ VFD's
____ RTU's

Commissioning of the Mechanical renovations, and confirm interconnection with the fire alarm system. The commissioning will be limited to:

HVAC:	Plumbing	Electrical
- Terminal Heating & Cooling Equipment		
- ATC System		- Electric Power Distribution
- Fans		
- Ductwork/Insulation/Hangers		

And items noted in Paragraph 1.4.

Commissioning and review of the TAB settings.

Team Member	Co. & Contact Names	Voice, office, cell, fax, email, address
Owner Project Manager		
Site Engineer		
Property Manager		
Construction Manager General Site Contact		
Mechanical		
General Contractor		
Site Supervisor Site Coordinator		
Commissioning Authority		
Architect		
Mechanical Designer/Eng.		
Electrical Designer/Eng.		
Owner's Representative		
Mechanical Contractor HVAC Site Superv.		
Piping Contractor		
Sheet Metal Contractor		
Electrical Contractor		
Site Supervisor		
TAB Contractor		
Controls Contractor Project Manager Project Engineer		

4. ROLES AND RESPONSIBILITIES

4.1 Locations of Role Descriptions [Bid Docs]

A. Descriptions and explanations of the roles and responsibilities of those in the commissioning process are found in the following places in the Contract Documents:

List of team members: *Cx Plan*, 4.2

Management plan outline: *Cx Plan*, 4.3. Specifications _____

General roles: *Cx Plan*, 4.4, Specifications _____

Specific responsibilities:

Information for all parties:	_____
OR:	*See all parts*
Mechanical contractor, TAB, Controls Contractor, subs and mfr's:	Specs 230500 thru 238200
Plumbing Sections	223300 & 334800
Electrical Contractor, subs and mfr's:	260500 & 265600
Commissioning Authority:	230800
A/E:	A/E Contract
TAB*:*	Specs 230593

4.2 TEAM MEMBERS

A. The members of the commissioning team consist of the ICA, OR, assigned members of the A/E (particularly the Mechanical Engineer), the mechanical contractor, electrical contractor, TAB representative, controls contractor, any other installing subcontractors or suppliers of equipment.

4.3 GENERAL MANAGEMENT PLAN [BID DOCS]

A. The ICA was hired by the Owner directly thru the Construction Manager and reports directly to the O.R. In general, the ICA coordinates the commissioning activities and reports to the Owner. The ICA's responsibilities, along with all other contractors' commissioning responsibilities are detailed in the specifications. The Specifications will take precedence over this Cx Plan. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents. Refer to the management protocols section below.

4.4 GENERAL DESCRIPTIONS OF ROLES

A. General descriptions of the commissioning roles are as follows:

ICA : Coordinates the Cx process with GC and O.R., and documents performance tests. All test reports shall be reviewed by the office of the A/E.

OR :	Facilitates the Cx process, ensures that Subs perform their responsibilities and integrates Cx into the construction process and schedule
Subs:	Demonstrate proper system performance
A/E	Perform construction observation, approve O&M manuals and assist in resolving problems
PM:	Facilitates and supports the Cx process and gives final approval of the Cx work
CM:	Coordinates Cx activities with Subs
Mfr :	The equipment manufacturers and vendors provide documentation to facilitate the commissioning work and perform contracted startup

5. COMMISSIONING PROCESS

This section sequentially details the commissioning process by commissioning task or activity.

5.1 COMMISSIONING SCOPING MEETING [BID DOCS]

A. A commissioning scoping meeting is planned and conducted by the ICA within ten (10) days after signing the contract. In attendance are the respective representatives of the OR, ICA, and the mechanical, electrical, controls, and TAB subs. At the meeting commissioning parties are introduced and the commissioning process reviewed, management and reporting lines determined. The flow of documents, how much submittal data the ICA will receive, etc. are also being discussed. The *Cx Plan* is reviewed, process questions are addressed, lines of reporting and communications determined and the work products list discussed. Also covered are the general list of each party's responsibilities, who is responsible to develop the startup plan for each piece of equipment and the proposed commissioning schedule. The outcome of the meeting is increased understanding by all parties of the commissioning process and their respective responsibilities. The meeting provides the ICA additional information needed to finalize the *Cx Plan*, including the commissioning schedule.

B. Prior to this meeting the ICA is given, by the A/E, all drawings and specifications and the construction schedule by trade. The ICA keeps notes from the meeting and distributes them to each team member.

5.2 FINAL COMMISSIONING PLAN-CONSTRUCTION PHASE [BID DOCS]

A. The CA finalizes the draft *Cx Plan* using the information gathered from the scoping meeting. The initial commissioning schedule is also developed along with a detailed timeline using *Detailed Commissioning Schedule*. The timeline is fine-tuned as construction progresses. In particular, 30 days prior to startup of the primary equipment, the CA meets with the GC and OR and develops a detailed commissioning schedule. The commissioning plan is approved by the OR

5.3 SITE OBSERVATION

A. The ICA, and OR if applicable, makes periodic visits to the site, as necessary, to witness equipment and system installations.

5.4 MISCELLANEOUS MEETINGS

A. The ICA attends selected planning and job-site meetings in order to remain informed on construction progress and to update parties involved in commissioning. The A/E provide the ICA with information regarding substitutions, change orders and any Architect's Supplemental Instructions (ASI) that may affect commissioning equipment, systems or the commissioning schedule. The ICA may review construction meeting minutes, change orders or ASIs for the same purpose.

B. Later during construction, necessary meetings between various commissioning team parties will be scheduled by the ICA, through the OR, as required.

5.5 MISCELLANEOUS MANAGEMENT PROTOCOLS

The following protocols will be used on this project.

Issue	**Protocol**
For requests for information (RFI) or formal documentation requests:	The ICA goes first: ___ direct to Sub or A/E, _X__through the CM, ___through OR.
For minor or verbal information and clarifications:	The ICA goes direct to the informed party.
For notifying contractors of deficiencies:	The ICA documents deficiencies through the OR & CM but may discuss deficiency issues with contractors prior to notifying the OR.
For scheduling functional tests or training:	_X__The ICA may provide input for and do some coordination of training and testing, but does not do any scheduling. This is through the CM,
For scheduling commissioning meetings:	The ICA selects the date and schedules through the: _X__ OR Engineer to be notified & CM. ___The ICA schedules and notifies attendees directly.
For making a request for significant changes:	The ICA has no authority to issue change orders.
For making small changes in specified sequences of operations:	___The ICA may make small sequences of operations changes to improve efficiency or control or to correct deficiencies, through the responsible contractor, but shall document the change and provide all changes of specified sequences to the GC and A/E. _X__The ICA may not make changes to specified sequences without approval from the A/E and OR.
Subcontractors disagreeing with requests or interpretations by the ICA shall:	Try and resolve with the ICA first. Then work through OR & CM who will work with ICA directly or through the Engineer to resolve the situation.
Function/Operation of Systems:	To be discussed with Engineer to understand design intention. No changes in function/operation to be made without Engineer's authorization.

5.6 PROGRESS REPORTING AND LOGS (CONSTRUCTION ALREADY IN PROGRESS)

A. At the beginning of construction, the ICA provides the OR with bi-monthly commissioning progress reports by e-mail. Ten (10) days prior to the startup of the first piece of major equipment, the frequency of progress reports is increased weekly, until startup is completed before functional testing of equipment begins, daily progress reports are required until functional testing and all non-conformance issues are resolved. The OR may adjust the reporting frequency as needed. The progress reports contain: an update of the schedule with list of requested schedule changes and new items added to the schedule, a list of new and outstanding deficiencies, a description of commissioning progress corresponding to the plan, etc. *Commissioning Progress Report* will be by e-mails provides a format for this report. The ICA keeps a log of all commissioning-related issues that require current or future attention. E-mails will provide a form for tracking the status of documentation and testing for each piece of equipment and system (e.g., installer, party responsible for startup, approval dates for checklist and testing forms, their completion, training, O&M documentation review, etc.).

B. The ICA regularly communicates with the OR and GC, keeping them apprised of the Commissioning process, and scheduling issues through memos, progress reports, etc. by e-mail.

The ICA will keep all commissioning materials in an organized notebook.

5.7 INITIAL SUBMITTALS AND DOCUMENTATION

5.7.1 Standard Submittals

A. The ICA provides all Subs responsible for commissioned equipment with commissioning documentation requirements for their respective equipment and systems through the OR. This data request typically coincides with the normal submittal process. At minimum, this equipment data includes installation and start-up procedures, O&M data, performance data and drawings. The ICA shall receive “approved” copies of submittals relative to commissioning issues expressed in the contract documents from the OR/GC, all comments concerning submittals shall be directed to the OR/CM submitted on RFI’s provides documentation request and tracking forms for representative equipment and acts as the tracking mechanism for documentation. It can also be used as the checkoff sheet for part of the final O&M documentation review. CA recommendations are provided to the A/E, or OR as directed.

5.7.2 Special Submittals, Notifications and Clarifications

A. The Subs, OR, CM or A/E notify the ICA of any new design intent or operating parameter changes, added control strategies and sequences of operation, or other change orders that may affect commissioned systems. The controls contractor provides the ICA a full points list with details requested by the ICA Thirty (30) days prior to performing owner-contracted tests, the Subs provide the ICA full details of the procedures. As the phases of the TAB are completed, a copy of the draft TAB reports is provided to the A/E by the OR with full explanations of approach, methods, results, data table legends, etc. A/E shall notify OR of significant deficiencies, which will be inferred to the ICA, and appropriate sub-contractors with direction to

meet design criteria by the A/E. The ICA may submit written RFI's to the A/E through the OR, (Form C-3d). A copy of the final TAB report shall be provided to the ICA upon completion.

5.8 PREFUNCTIONAL CHECKLISTS, TESTS AND STARTUP (SEE 1.4 ABOVE FOR THE ITEMS COVERED)

A. Prefunctional checklists (PC) are important to ensure that the equipment and systems are hooked up and operational and that functional performance testing may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout by the Contractor. No sampling strategies are used. In general, the prefunctional testing for a given system, must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.

B. Prefunctional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., oil levels OK, fan belt tension, labels affixed, gages in place, sensor calibration, etc.). However, some prefunctional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three phase pump motor of a chiller system). The word <u>pre</u>functional refers to <u>before</u> functional testing. Prefunctional checklists augment and are combined with the manufacturer's start-up checklist.

B. Contractors typically already perform some, if not many, of the prefunctional checklist items the commissioning authority will recommend. However, few contractors document in writing the execution of these checklist items. This project requires that the procedures be documented in writing by the installing technician. The ICA does not witness much of the prefunctional checklisting, except for testing of larger or more critical pieces of equipment and some spot-checking.

5.8.1 Start-up Plan

The ICA assists the commissioning team members responsible for startup in developing detailed start-up plans for all equipment. The parties responsible for each part of startup and initial checkout are identified on the prefunctional checklists. Refer to

A. _X__The following procedures will be used for this project: (the ICA is responsible for the plan development):

1. The ICA adapts and enhances, if necessary, the representative prefunctional checklists (PC) and procedures from the lists in Specification, and develops original lists, as necessary.
2. The ICA obtains manufacturer installation, startup and checkout data, including actual field checkout sheets used by the field technicians from the contractor (through an RFI).
3. The ICA copies all pages with important instructional data and procedures from the startup and checkout manuals not covered in manufacturer field checkout sheets and adds a signature line in the column by each procedure.
4. The copied pages from (2), along with the prefunctional checklist provided by the ICA and the manufacturer field checkout sheets become the "Startup and Checkout Plan."

5. For systems that may not have adequate manufacturer startup and checkout procedures, particularly for components being integrated with other equipment, the Sub should provide the added necessary detail and documenting format to the ICA for approval, prior to execution.
6. The ICA transmits the full Startup Plan to the OR and GC, who designates which trade or contractor is responsible to fill out each line item (mark in the "Contr" column) on the Prefunctional Checklist from the ICA. The OR then transmits the full start-up plan to the Subs for their review and use. (This usually means that the Prefunctional Checklist, alone, will go to more than one Sub, while the full plan will go to the primary installing contractor.)

5.8.2 Execution of Checklists and Startup

A. Four weeks prior to startup, the Subs and vendors schedule startup and initial checkout with the OR, GC and ICA. The startup and initial checkout are directed and executed by the Sub or vendor. The ICA, OR and GC if necessary, observe, at minimum, the procedures for each piece of primary equipment. To document the process of startup and checkout, the site technician performing the line item task initials and dates each paragraph of procedures in the "Startup Plan" and checks off items on the prefunctional and manufacturer field checkout sheets, as they are completed. Only individuals having direct knowledge of a line item being completed shall check or initial the forms.

B. The Subs and vendors execute the checklists and tests and submit a signed copy of the completed start-up and prefunctional tests and checklists to the ICA. The ICA may review prefunctional checklists in progress, as necessary. On smaller equipment or projects, the checklists (which all contain more than one trade's responsibility), may be passed around to the Subs to fill out. For larger projects, each trade may need a full form and the ICA will consolidate them later.

5.8.3 Sampling Strategy for ICA Observation of Prefunctional Checkout and Startup

A. The following table provides a tentative list of the equipment and how much of the prefunctional checkout and startup work will be witnessed by the commissioning authority.

Equipment or System	**Fraction To Be Observed by ICA**
Building automation system	Observe checkout and calibration-100%
TAB work	Observe 1 hour of TAB & Spot Check
Other misc. equipment	As necessary
Volume dampers	25% & confirmed position marked by TAB
Fire Alarm	
Domestic Water Heaters	100%
HVAC System	100%

5.8.4 Deficiencies and Non-Conformance

A. The Subs clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully at the bottom of the procedures form or on an attached sheet. The procedures form and deficiencies are provided to the ICA within two days of test completion. The ICA works with the Subs and vendors to correct and retest deficiencies or uncompleted items, involving the OR/GC and others as necessary. The installing Subs or vendors correct all areas that are deficient or incomplete according to the checklists and tests. The ICA recommends approval of the startup and initial checkout of each system to the OR. Further details are found in the Specifications.

5.8.5 Phased Commissioning

A. Because of project size, this project ___will require, _X__will not require startup and initial checkout to be executed in phases, with summer cooling waiting until the weather changes.

5.8.6 TAB

A. The TAB Contractor submits the outline of the TAB plan one (1) week "prior" to starting the TAB, and approach to the OR/CM for distribution to the A/E, ICA, MC, for review. Included in the approach, is an explanation of the intended use of the building control system. The ICA reviews the plan and approach for understanding and coordination issues and may comment, but does not "approve." The controls contractor reviews the feasibility of using the building control system for assistance in the TAB work. The TAB submits weekly written reports of discrepancies, contract interpretation requests and lists of completed tests to the ICA and OR. This facilitates quicker resolution of problems and will result in a more complete TAB before functional testing begins. A checklist form for reviewing the TAB plan is provided as one of the prefunctional checklists in Specifications.

B. TAB work will not begin until the control system has been prefunctionally tested and selective functional tests have been performed and approved by the ICA.

5.8.7 Controls Checkout Plan

A. The MC develops, and submits a written step-by-step controls plan to the OR/GC for distribution to the A/E, and ICA which describes the process they intend to follow in checking out the control system, and the forms they intend to use to document the process. The MC will also meet with the TAB contractor prior to the start of TAB and review the TAB plan to determine the capabilities of the control system for use in TAB. The controls contractor will provide the TAB with any necessary unique instruments for setting terminal unit boxes and instruct TAB in their use. The MC shall also provide a technician qualified to operate the controls to assist the TAB contractor in performing TAB. Additional details are found in Specifications.

B. All CA-required controls prefunctional checklists, calibrations, start-up and selected functional tests of the system shall be completed and approved by the ICA prior to TAB. The MC shall execute the tests and trend logs assigned to them in Section 230900 and remain on site for assistance for mechanical system functional tests as specified in the same sections.

5.9 DEVELOPMENT OF FUNCTIONAL TEST AND VERIFICATION PROCEDURES

5.9.1 Overview

A. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, varying outside air temperatures, fire alarm, etc. The systems are run through all of the control system's sequences of operation and components are verified to be responding as the sequences state. The commissioning authority develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor.

5.9.2 Scope of Testing [Bid Docs]

A. The specification "Testing Requirements" (See Specifications) provide specific functional testing scope for each piece of commissioned equipment. A detailed description of the functional and prefunctional testing procedures and process is per the specifications.

5.9.3 Development Process

A. Before test procedures are written, the ICA obtains all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, control sequences and setpoints. The ICA develops specific test procedures to verify proper operation of each piece of equipment and system. The ICA obtains clarification, as needed, from contractors and the A/E regarding sequences and operation to develop these tests. Prior to execution, the ICA provides a copy of the primary equipment tests to the installing Sub (via the GC) who reviews the tests for feasibility, safety, warranty and equipment protection. Functional testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance. The ICA follows the Specifications when given and uses judgment where needed to determine which method is most appropriate. According to the Specifications, not all pieces of identical equipment receive in-depth testing. The ICA reviews owner-contracted, factory or required owner acceptance tests and determines what further testing may be required to comply with the Specifications.

5.9.4 Testing Plan Overview

A. To provide the contractors with a better idea of where functional testing lies in the schedule, what issues are preventing the start of testing, which contractors are needed for each test and how much time might be expected from them by e-mail. This is submitted after most equipment has been started up and when functional testing dates are not too far off. The form is provided to the Contractors to assist in moving more efficiently to functional testing.

5.10 EXECUTION OF FUNCTIONAL TESTING PROCEDURES

5.10.1 Overview and Process

A. The ICA schedules functional tests through the OR and affected Subs. For any given system, prior to performing functional testing, the ICA waits until the prefunctional checklist has been submitted with the necessary signatures, confirming that the system is ready for functional

testing. The ICA oversees, witnesses and documents the functional testing of all equipment and systems according to the Specifications and the Cx Plan. The Subs execute the tests. The control system is tested before it is used to verify performance of other components or systems. The air balancing is completed and debugged before functional testing of air-related equipment or systems. Testing proceeds from components to subsystems to systems and finally to interlocks and connections between systems. Refer to Section 6 for details on functional testing scope.

5.10.2 Deficiencies and Retesting

A. The ICA documents the results of the test. Corrections of minor deficiencies identified are made during the tests at the discretion of the ICA. The ICA records the results of the test on the procedure or test form. Deficiencies or non-conformance issues are noted and reported to the OR and GC by e-mail. Subs correct deficiencies, notify the ICA by e-mail. The ICA schedules retesting through the OR/GC. Decisions regarding deficiencies and corrections are made at as low a level as possible, preferably between ICA and the Sub. For areas in dispute, final authority, besides the Owner's, resides with the A/E. The ICA recommends acceptance of each test to the OR. The OR gives final approval on each test.

5.10.3 Facility Staff Participation

A. The Owner's facilities operating staff are encouraged to attend and participate in the testing process. This form does not describe their involvement in formal training. The ICA will notify the _X_OR, ___PM, who will then notify the facility staff when the commissioning events will occur.

5.10.4 Phased Testing

A, Refer to Section 5.8.5 for details regarding testing the equipment or systems in phases. Owner to determine if a summer test of equipment's capacity is required.

5.10.5 Sampling

A. Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy.

5.11 O&M MANUALS AND WARRANTIES

5.11.1 Standard O&M Manuals

A. The OR, and ICA review the O&M Manuals, equipment documentation, warranties and redline as-builts for the systems (Division 23 Specifications) that were commissioned to verify compliance. The manuals are then submitted to the A/E for approval, and acceptance of these sections of the O&M Manuals. Refer to Specifications, and 5.11.2 commissioning Record for format.

5.11.2 Commissioning Record

A. The CA will compile, organize and index the following commissioning data by equipment into labeled, indexed and tabbed, three-ring binders and deliver it to the OR and Architect, to be included with the O&M manuals. The correspondence, meeting minutes and progress reports,

miscellaneous notes, etc. kept in the Commissioning Record Book during construction will not be retained into this record and the O&M manuals. The format of the manual follows:

General

Tab I-1 Commissioning Plan & Owner's Project Requirements
Tab I-2 Final Commissioning Report
Tab I-3 Issues Log (record of deficiencies, e-mails)
Tab I-4 Progress Record (Form C-7)

Equipment Specific

Tab 01 System Type 1 (ERV-1, etc..)
- *Sub-Tab A* Design narrative and criteria, sequences, approvals for Equipment 1
- *Sub-Tab B* Start-up plan and report, approvals, corrections, blank prefunctional checklists —for each equipment type (coils, etc.)
- *Sub-Tab C* Functional tests (completed), trending and analysis, approvals and corrections, training plan, record and approvals, blank functional test forms and a recommended recommissioning schedule.

Tab 02 System Type 2.....repeat as per System One

This will be submitted to the USGBC for documentation by the Architect for LEED certification.

5.12 TRAINING AND ORIENTATION OF OWNER PERSONNEL

A. Owner training and orientation on equipment and systems provided by the Contractor is accomplished in three general steps using three forms.

1. Overall Plan. After reviewing the Specifications, the OR and ICA shall fill out a table listing all of the equipment for training, and submit plan to the A/E for approval. The MC and EC shall provide training for all components controlled by the BAC Building Automated System in accordance with Specification 230900.
2. Specific Training Agendas. For each piece of equipment or system for which training is provided, the Owner and ICA fill out Section 2 *Training and Orientation Agenda*. This section includes some of the information regarding the scope of training and the intended audience, for reference by the trainer in developing the training agenda. The ICA develops a plan for including in the training session contractors / trainers from different disciplines, when appropriate, by listing their company names on 2 of the form. In particular, the controls contractor will provide brief training on controls in the same session with the mechanical training for equipment controlled by the building automation system.
3. This form is then submitted to the Contractor Trainer(s) to fill out the remainder of Sections 2 and 3 of the form describing the subjects covered, duration of each subject, and methods that will be used in training. The trainer(s) returns this form to the OR and ICA for review "prior" to submitting the agenda to the A/E for final approval. The OR provides the approved agenda to the trainer(s) to use during training and provides a copy of the agenda to each trainee.
4. Training Record. For each piece of equipment, prior to training, the OR and ICA provides each trainer with a training check sheet. On this form, the trainer documents each training session (duration, and general subjects covered). The trainer signs for the session, and obtains signatures of each trainee. The trainer also checks off subjects covered on the Agenda When training is complete,

the OR provides a copy of the Training Agenda, and Orientation Record to the Owner, A/E and ICA. All parties review, and approve before signing it.

5.12.1 Special Training and Orientation

The following checked orientation and trainings will be completed by the ICA and A/E according to the specifications:

___ Recommissioning. The commissioning authority will provide instruction on the use of blank functional test forms for periodic recommissioning of equipment and systems, per the specification.

___ Architect. The architect will provide a general overview of the facility, its use, special features, tenant and public considerations, etc.

___ Mechanical Design Engineer. The mechanical designer will provide an overview of the major systems and equipment in the facility, including for each system: the design intent, why the system was chosen, an overview of its operation, and interactions with other systems, any special areas to be aware of, issues regarding future expansion and remodeling, etc.

___ Electrical Design Engineer. The electrical designer will provide an overview of the major electrical systems and equipment in the facility, particularly the lighting control systems, fire alarm, security and emergency power, focusing on the design intent, why the system was chosen, an overview of its operation, and interactions with other systems, any special areas to be aware of, issues regarding future expansion and remodeling, etc.

5.13 Warranty Period

A. During the warranty period, seasonal testing (heating and cooling) and other deferred testing required is completed according to the Specifications. The ICA coordinates this activity. Tests are executed and deficiencies corrected by the appropriate Subs, witnessed by facilities staff and the ICA. Any final adjustments to the O&M manuals and as-builts due to the testing are made for seasonal testing details for this project.

6. WRITTEN WORK PRODUCTS [Bid Docs]

A. The table describes each product, who is responsible for producing it, the general due date, the parties who receive it and who approves it, etc.

6.1 Summary Report

A. A final summary report by the ICA will be provided to the OR. The report shall include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope and a general description of testing and verification methods. For each piece of commissioned equipment, the report should contain the disposition of the commissioning authority regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas: 1) Equipment meeting the equipment specifications, 2) Equipment installation, 3) Functional performance and efficiency, 4) Equipment documentation and design intent, and 5) Operator training. All outstanding non-compliance items shall be specifically listed. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed. Each non-

compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented. The functional performance and efficiency section for each piece of equipment shall include a brief description of the verification method used (manual testing, BAS) and include observations and conclusions from the testing.

B. Appendices shall contain acquired sequence documentation, logs, meeting minutes, progress reports, deficiency lists, site visit reports, findings, unresolved issues, communications, etc. Prefunctional checklists and functional tests (along with blanks for the operators) and monitoring data and analysis will be provided in a separate labeled binder.

C. The commissioning plan, the prefunctional checklists, functional tests and monitoring reports will not be part of the final report, but will be stored in the Commissioning Record in the O&M manuals, as described in the specification Section 230050.

7. SCHEDULE

7.1 General Issues [Bid Docs]

The following sequential priorities are followed:

1. Equipment is not “temporarily” started (for heating or cooling), until pre-start checklist items and all manufacturers’ pre-start procedures are completed and moisture, dust and other environmental and building integrity issues have been addressed.
2. Functional testing is not begun until prefunctional and start-up and TAB is completed, for a given system.
3. The controls system and equipment it controls are not functionally tested until all points have been calibrated and pre-functional testing completed.
4. TAB is not performed until the controls system has been sufficiently functionally tested and approved by the ICA for TAB work.
5. TAB is not performed until the envelope is completely enclosed and ceiling complete, unless the return are is ducted.

7.2 PROJECT SCHEDULE

The initial commissioning schedule is summarized in Table 7-1.

Table 7-1. Initial Commissioning Schedule Summary

Task / Activity	Estimated Start Date	Estimated End Date
Initial scoping meeting and final plan		
Submittals obtained and reviewed		
Begin construction site visits/inspections		
Prefunctional forms developed and distributed		
Startup and initial checkout plans		
Startup and initial checkout executed		

TAB Air & Water		
Functional performance tests		
O&M documentation review and verification		
Training and training verification		
Final commissioning report		
Seasonal testing		

END OF SECTION 23 08 00

SECTION 23 09 50 - BUILDING AUTOMATION SYSTEM (BAS) GENERAL

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. General Requirements

B. Description of Work

C. Quality Assurance

D. System Architecture

E. Distributed Processing Units/Quantity and Location

F. Demolition and Reuse of Existing Materials and Equipment

G. Sequence of Work

1.02 RELATED DOCUMENTS

A. Section 23 09 69 - Variable Frequency Controllers

B. Section 23 09 51 - Building Automation System (BAS) Basic Materials, Interface Devices, and Sensors

C. Section 23 09 53 - BAS Field Panels

D. Section 23 09 54 - BAS Communication Devices

E. Section 23 09 55 - BAS Software and Programming

F. Section 23 09 58 - Sequences of Operation

G. Section 23 09 59 - BAS Commissioning

1.03 DESCRIPTION OF WORK

A. The building automation system (BAS) defined in this specification shall interface with the Delaware Technical Community college Network , and shall utilize the BACnet communication requirements as defined by ASHRAE/ANSI 135 (current version and addendum) for all communication.

The successful DDC/ATC Controls Installer must engage CM3 Building Solutions to interface the DDC Controls of The Office of the President into the existing Campus DDC Control Network and Operator's Workstations (2 total) through BACnet or the LONtalk Open Protocol Communications.

B. Contractor shall furnish and install building automation system (BAS). The BAS/addition shall utilize electronic sensing, microprocessor-based digital control, and electronic actuation of dampers and valves to perform control sequences and functions specified.

The BAS/addition for this project will generally consist of monitoring and control of systems listed below. Reference also to control drawings, sequences of operation, and points lists.

C. The systems to be controlled under work of this section basically are in support of an addition and renovations to the DTCC President's Office Building including but not limited to the following equipment or systems:

Outside Air Energy Recovery Ventilator
Exhaust Fans
Water Source Heat Pumps
Boiler
Cooling Tower
Pumps

This Section defines the manner and method by which these controls function. This project is an addition or expansion of the existing system that will utilize existing user interface and campus communications systems already installed.
The look, feel, organization and appearance of the existing system shall be maintained as much as possible while meeting the requirements of the systems that are part of the building addition.

The existing BAS is IA Series by Schneider Electric, installed and maintained by CM3 Building Solutions. Contact: Frank McFadden

1.04 APPLICATION OF OPEN PROTOCOLS

A. Subject to the detailed requirements provided throughout the specifications, the BAS and digital control and communications components installed, as work of this contract shall be an integrated distributed processing system utilizing BACnet. System components shall communicate using native BACnet or LonTalk in accordance with ASHRAE Standard 135 and current addenda and annexes, including all workstations, all building controllers, and all application specific controllers. LonTalk open communication is acceptable. Gateways to other communication protocols are not acceptable.

1.05 QUALITY ASSURANCE

A. Product Line Demonstrated History: The product line being proposed for the project must have an installed history of demonstrated satisfactory operation for a length of two (2) years since date of final completion in at least ten (10) installations of comparative size and complexity. Submittals shall document this requirement with references.

The following requirement relates to the actual installing contractor.

B. Installer's Qualifications: Firms specializing and experienced in control system installations for not less than five (5) years. Firms with experience in BAS installation projects with

point counts equal to this project and systems of the same character as this project. If installer is a Value Added Reseller (VAR) of a manufacturer's product, installer must demonstrate at least three (3) years prior experience with that manufacturer's products. Experience starts with awarded Final Completion of previous projects. Submittals must document this experience with references.

C. Installer's Experience with Proposed Product Line: Firms shall have specialized in and be experienced with the installation of the proposed product line for not less than one year from date of final completion on at least three (3) projects of similar size and complexity. Submittals shall document this experience with references.

D. Installer's Field Coordinator and Sequence Programmer Qualifications: Individual(s) shall specialize in and be experienced with control system installation for not less than five (5) years. Proposed field coordinator shall have experience with the installation of the proposed product line for not less than tow (2) projects of similar size and complexity. Installer shall submit the names of the proposed individual and at least one (1) alternate for each duty. Submittals shall document this experience with references. The proposed individuals must show proof of the following training:
   1. Product Line Training: Individuals overseeing the installation and configuration of the proposed product line must provide evidence of the most advanced training offered by the Manufacturer on that product line for installation and configuration
   2. Programming Training: Individuals involved with programming the site-specific sequences shall provide evidence of the most advanced programming training offered by the vendor of the programming application offered by the Manufacturer.

E. Installer's Service Qualifications: The installer must be experienced in control system operation, maintenance and service. Installer must document a minimum five (5) year history of servicing installations of similar size and complexity. Installer must also document at least a one (1) year history of servicing the proposed product line.

F. Installer's Response Time and Proximity
   1. Installer must maintain a fully capable service facility within a 45 mile radius of the project site. Service facility shall manage the emergency service dispatches and maintain the inventory of spare parts.
   2. Emergency response times are listed below in this section. Installer must demonstrate the ability to meet the response times.

1.06 CODES AND STANDARDS

A. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
   1. ASHRAE 135: BACnet - A Data Communication Protocol for Building Automation and Control Networks. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. current edition including all related addenda shall apply.

B. Electronics Industries Alliance
   1. EIA-709.1-A-99: Control Network Protocol Specification

2. EIA-709.3-99: Free-Topology Twisted-Pair Channel Specification
3. EIA-232: Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
4. EIA-458: Standard Optical Fiber Material Classes and Preferred Sizes
5. EIA-485: Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multipoint Systems.
6. EIA-472: General and Sectional Specifications for Fiber Optic Cable
7. EIA-475: Generic and Sectional Specifications for Fiber Optic Connectors and all Sectional Specifications
8. EIA-573: Generic and Sectional Specifications for Field Portable Polishing Device for Preparation Optical Fiber and all Sectional Specifications
9. EIA-590: Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant and all Sectional Specifications

C. Underwriters Laboratories
1. UL 916: Energy Management Systems.
The following rating is required only for devices used for smoke control purposes. If these are not intended, delete.
2. UUKL 864: UL Supervised Smoke Control

D. NEMA Compliance
1. NEMA 250: Enclosure for Electrical Equipment
2. NEMA ICS 1: General Standards for Industrial Controls.

E. NFPA Compliance
1. NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.
2. NFPA 70 National Electrical Code (NEC)

F. Institute of Electrical and Electronics Engineers (IEEE)
1. IEEE 142: Recommended Practice for Grounding of Industrial and Commercial Power Systems
2. IEEE 802.3: CSMA/CD (Ethernet - Based) LAN
3. IEEE 802.4: Token Bus Working Group (ARCNET - Based) LAN

1.07 DEFINITIONS

A. Advanced Application Controller (AAC): A device with limited resources relative to the Building Controller (BC). It may support a level of programming and may also be intended for application specific applications.

B. Application Protocol Data Unit (APDU): A unit of data specified in an application protocol and consisting of application protocol control information and possible application user data (ISO 9545).

C. Application Specific Controller (ASC): A device with limited resources relative to the Advanced Application Controller (AAC). It may support a level of programming and may also be intended for application-specific applications. .

D. BACnet/BACnet Standard: BACnet communication requirements as defined by ASHRAE / ANSI 135 (Current edition and addendum).

E. BACnet Interoperability Building Blocks (BIBB): A BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBS are combined to build the BACnet functional requirements for a device in a specification.

F. Binding: In the general sense, binding refers to the associations or mappings of the sources network variable and their intended opr required destinations.

G. Building Automation System (BAS): The entire integrated management and control system

H. Building Controller (BC): A fully programmable device capable of carrying out a number of tasks including control and monitoring via direct digital control (DDC) of specific systems, acting as a communications router between the controlled devices / equipment and the CSS, and temporary data storage for trend information, time schedules, and alarm data.

I. Change of Value (COV): An event that occurs when a measured or calculated analog value changes by a predefined amount (ASHRAE/ANSI 135 (current version and addendum)).

J. Client: A device that is the requestor of services from a server. A client device makes requests of and receives responses from a server device.

K. Continuous Monitoring: A sampling and recording of a variable based on time or change of state (e.g. trending an analog value, monitoring a binary change of state).

L. Controller or Control Unit (CU): Intelligent stand-alone control device. Controller is a generic reference and shall include BCs, AACs, and ASCs as appropriate.

M. Control Systems Server (CSS): A server class computer(s) that maintains the systems configuration and programming database. This server is located at the State of Delaware's data center in a virtual environment and serves as an access point to BAS.

N. Controlling LAN: High speed, peer-to-peer controller LAN connecting BCs, AACs and ASCs. Refer to System Architecture below.

O. Direct Digital Control (DDC): Microprocessor-based control including Analog/Digital conversion and program logic

P. Functional Profile: A collection of variables required to define a the key parameters for a standard application. As this applies to the HVAC industry, this would include applications like VAV terminal, fan coil units, and the like.

Q. Gateway (GTWY): A device, which contains two or more dissimilar networks/protocols, permitting information exchange between them.

R. Hand Held Device (HHD): Manufacturer's microprocessor based device for direct connection to a Controller.

S. LAN Interface Device (LANID): Device or function used to facilitate communication and sharing of data throughout the BAS

T. Local Area Network (LAN): General term for a network segment within the architecture. Various types and functions of LANs are defined herein.

U. Local Supervisory LAN: Also known as the State's Network: Ethernet-based network connecting Primary Controlling LANs with each other and OWSs and CSSs. See System Architecture below.

V. Master-Slave/Token Passing (MS/TP): Data link protocol as defined by the BACnet standard.

W. Open Database Connectivity (ODBC): An open standard application-programming interface (API) for accessing a database developed. ODBC compliant systems make it possible to access any data from any application, regardless of which database management system (DBMS) is handling the data.

X. Operator Interface (OI): A device used by the operator to manage the BAS including OWSs, POTs, and HHDs.

Y. Operator Workstation (OWS): The user's interface with the BAS system. As the BAS network devices are stand-alone, dedicated OWS is not required for communications to occur. The OWS can be any computer on the State's Network that has a compatible Web browser.

Z. Point-to-Point (PTP): Serial communication as defined in the BACnet standard.

AA. Portable Operators Terminal (POT): Mobile computer used both for direct connection to a controller as well as network connection.

AB. Protocol Implementation Conformance Statement (PICS): A written document, created by the manufacturer of a device, which identifies the particular options specified by BACnet that are implemented in the device (ASHRAE/ANSI 135 (current version and addendum)).

AC. Router: A device that connects two or more networks at the network layer.

AD. Secondary Controlling LAN: LAN connecting AACs and ASCs, generally lower speed and less reliable than the Controlling LAN. Refer to System Architecture below.

AE. Server : A device that is a provider of services to a client. A client device makes requests of and receives responses from a server device.

AF. Standardized Query Language (SQL): A database computer language designed for managing data in relational database management system (RDBMS). Its scope includes data insert, query, update and delete, schema creation and modification, and data access control.

AG. Smart Device: A control I/O device such as a sensor or actuator that can directly communicate with a controller through the network. This differs from an ASC in that it typically deals only with one variable.

AH. Extensible Markup Language (XML): A specification developed by the World Wide

Web Consortium. XML is a pared-down version of SGML, designed especially for Web documents. It is a set of rules for encoding documents in machine-readable form that allows designers to create their own customized tags, enabling the definition, transmission, validation, and interpretation of data between applications and between organizations.

1.08 FUNCTIONAL INTENT

A. Throughout Sections 23 09 50 through 23 09 55, the Sequences of Operation, and Section 23 09 59 detailed requirements are specified, some of which indicate a means, method or configuration acceptable to meet that requirement. Contractor may submit products that utilize alternate means, methods, and configurations that meet the functional intent. However these will only be allowed with prior approval.

1.09 SUBMITTALS

A. Submit under provisions of Section 01 30 00.

B. Electronic Submittals: While all requirements for hard copy submittal apply, control submittals and O&M information shall also be provided in electronic format as follows.
   1. Drawings and Diagrams: Shop drawings shall be provided on electronic media as an AutoCAD (current version) and/or Adobe Portable Document Format file. All 'X reference' and font files must be provided with AutoCAD files.
   2. Other Submittals: All other submittals shall be provided in Adobe Portable Document Format (PDF).

C. Qualifications: Manufacturer, Installer, and Key personnel qualifications as indicated for the appropriate item above.

D. Product Data: Submit manufacturer's technical product data for each control device, panel, and accessory furnished, indicating dimensions, capacities, performance and electrical characteristics, and material finishes. Also include installation and start-up instructions.

E. Shop Drawings: Submit shop drawings for each control system, including a complete drawing for each water source heat pump, system, pump, device, etc. with all point descriptors, addresses and point names indicated. Each shop drawing shall contain the following information:
   1. System Architecture and System Layout:
      a. One-line diagram indicating schematic locations of all control units, workstations, LAN interface devices, gateways, etc. Indicate network number, device ID, , instance number, MAC address, drawing reference number, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. Indicate media, protocol, baud rate, and type of each LAN. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the diagram.
      b. Provide electronic floor plans locating all control units, workstations, LAN interface devices, gateways, etc. Include all network communication wiring routing, power wiring, power originating sources, and low voltage power wiring.

Indicate network number, device ID, instance number, MAC address, drawing reference number, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the floor plans. Wiring routing as-built conditions shall be maintained accurately throughout the construction period and the drawing shall be updated to accurately reflect accurate, actual installed conditions.

2. Schematic flow diagram of each air and water system showing fans, coils, dampers, valves, pumps, heat exchange equipment and control devices. Include verbal description of sequence of operation.
3. All physical points on the schematic flow diagram shall be indicated with names, descriptors, and point addresses identified as listed in the point summary table.
4. With each schematic, provide a point summary table listing building number and abbreviation, system type, equipment type, full point name, point description, Ethernet backbone network number, network number, device ID, object ID (object type, instance number). See Section 23 09 55 - Part III for additional requirements.
5. Label each control device with setting or adjustable range of control.
6. Label each input and output with the appropriate range.
7. Provide a Bill of Materials with each schematic. Indicate device identification to match schematic and actual field labeling, quantity, actual product ordering number, manufacturer, description, size, voltage range, pressure range, temperature range, etc. as applicable.
8. With each schematic, provide valve and actuator information including size, Cv, design flow, design pressure drop, manufacturer, model number, close off rating, etc. Indicate normal positions of spring return valves and dampers.
9. Indicate all required electrical wiring. Electrical wiring diagrams shall include both ladder logic type diagram for motor starter, control, and safety circuits and detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified. Provide panel termination drawings on separate drawings. Ladder diagrams shall appear on system schematic. Clearly differentiate between portions of wiring, which are existing, factory-installed and portions to be field-installed.
10. Details of control panels, including controls, instruments, and labeling shown in plan or elevation indicating the installed locations.
11. Sheets shall be consecutively numbered.
12. Each sheet shall have a title indicating the type of information included and the HVAC system controlled.
13. Table of Contents listing sheet titles and sheet numbers.
14. Legend and list of abbreviations.
15. Memory allocation projections.

16. Submit along with shop drawings but under separate cover calculated and guaranteed system response times of the most heavily loaded LAN in the system.

F. Open Protocol Information
   1. BACnet or LonTalk Systems:
      a. BACnet or LonTalk object description, object ID, and device ID, for each I/O point.
      b. Documentation for any non-standard BACnet or LonTalk objects, properties, or enumerations used detailing their structure, data types, and any associated lists of enumerated values.
      c. Submit PICS indicating the BACnet or LonTalk functionality and configuration of each controller.

G. Framed Control Drawings: Laminated control drawings including system control schematics, sequences of operation and panel termination drawings, shall be provided in panels for major pieces of equipment. Terminal unit drawings shall be located in the central plant equipment panel or mechanical room panel.

H. Control Logic Documentation
   1. Submit control logic program listings (for graphical programming) and logic flow charts (for line type programs) to document the control software of all control units.
   2. Control logic shall be annotated to describe how it accomplishes the sequence of operation. Annotations shall be sufficient to allow an operator to relate each program component (block or line) to corresponding portions of the specified Sequence of Operation.
   3. Include written description of each control sequence.
   4. Include control response, settings, setpoints, throttling ranges, gains, reset schedules, adjustable parameters and limits.
   5. Sheets shall be consecutively numbered.
   6. Each sheet shall have a title indicating the controller designations and the HVAC system controlled.
   7. Include Table of Contents listing sheet titles and sheet numbers
   8. Submit one complete set of programming and operating manuals for all digital controllers concurrently with control logic documentation. This set will count toward the required number of Operation and Maintenance materials specified below and in Section 01 30 00.

I. Operation and Maintenance Materials:
   1. Submit documents under provisions of Section 01 03 00. One copy of the materials shall be delivered directly to the State facilities operation staff, in addition to the copies required by other Sections.
   2. Submit maintenance instructions and spare parts lists for each type of control device, control unit, and accessory.
   3. Submit BAS User's Guides (Operating Manuals) for each controller type .
   4. Submit BAS advanced Programming Manuals for each controller type.
   5. Include all submittals (product data, shop drawings, control logic documentation,

hardware manuals, software manuals, installation guides or manuals, maintenance instructions and spare parts lists) in maintenance manual; in accordance with requirements of Division 1.

J. Controls Contractor shall provide the College with all product line technical manuals and technical bulletins, to include new and upgraded products, by the same distribution channel as to dealers or branches. This service will be provided for five (5) years as part of the contract price, and will be offered to the College thereafter for the same price as to a dealer or branch.

K. Manufacturers Certificates: For all listed and/or labeled products, provide certificate of conformance.

L. Product Warranty Certificates: submit manufacturers product warranty certificates covering the hardware provided.

1.10 PROJECT RECORD DOCUMENTS

A. Submit documents under provisions of Section 01 30 00.

B. Record copies of product data and control shop drawings updated to reflect the final installed condition.

C. Record copies of approved control logic programming and database on paper and on CD's. Accurately record actual setpoints and settings of controls, final sequence of operation, including changes to programs made after submission and approval of shop drawings and including changes to programs made during specified testing.

D. Record copies of approved project specific graphic software on CDs.

E. Record copies shall include individual floor plans with controller locations with all interconnecting wiring routing including space sensors, LAN wiring, power wiring, low voltage power wiring. Indicate device instance, MAC address and drawing reference number.

F. Provide record riser diagram showing the location of all controllers.

G. Maintain project record documents throughout the warranty period and submit final documents at the end of the warranty period

1.11 SYSTEM ARCHITECTURE

A. The system provided shall incorporate hardware resources sufficient to meet the functional requirements of these Specifications. The Contractor shall include all items not specifically itemized in these Specifications that are necessary to implement, maintain, and operate the system in compliance with the functional intent of these Specifications.

B. The system shall be configured as a distributed processing network(s) capable of expansion as specified below.

C. The system architecture shall consist of the Ethernet-based College Network, and Controlling LANs that support BCs, AACs, ASCs, Operator Workstations (OWS), Smart Devices (SD), and Remote Communication Devices (RCDs) as applicable. The following indicates a functional description of the BAS structure.
   1. College Network: Internet-based network connecting multiple facilities with a central data and application server, accessible via standard web-browser. This is an existing infrastructure and Contractor is not required to configure any components of this network. Refer to Section 23 09 54 for requirements. This Contractor shall integrate the controlling devices and the CCS together.
   2. Local Supervisory LAN: The Local Supervisory LAN shall be an Ethernet-based, 100 Mbps LAN connecting Primary Control LANs and OWSs. The LAN serves as the inter-BC gateway and OWS-to-BC gateway and communications path. Contractor shall provide this as a dedicated LAN for the control system. LAN shall be IEEE 802.3 Ethernet over Fiber
      or Category 5 cable with switches and routers that support 100 Mbps throughput. Power-line carrier communication shall not be acceptable for communications. The physical media will be that installed for the IT infrastructure of the facility and as such network drops will be provided under that scope of work to facilitate work of this scope. This network will be 100 Mbps and therefore all network interface cards shall support that speed.
   3. Controlling LAN: High-speed, peer-to-peer communicating LAN used to connect AACs, ASCs and Building Controllers (BCs) and communicate exclusively control information. Acceptable technologies include:
      a. Ethernet (IEEE802.3)
      b. ARCNET (IEEE802.4)
         shall utilize standard TCP/IP, BACnet/IP ports (80and/or 47808)
   4. Secondary Controlling LAN : Network used to connect AACs, ASCs or SDs. These can be Master Slave/ Token Passing or polling, in addition to those allowed for Primary Controller LANs. Network speed vs. the number of controllers on the LAN shall be dictated by the response time and trending requirements.

D. Dynamic Data Access: Any data throughout any level of the network shall be available to and accessible by all other devices, Controllers and OWS, whether directly connected or connected remotely.

E. Remote Data Access: The system shall support the following methods of remote access to the building data.
   1. Browser-based access: A remote user using a standard browser shall be able to access all control system facilities and graphics with proper authentication. The State shall maintain continuous network connection. The following paradigms are acceptable for browser-based access:
      a. Native Internet-based user interface (HTML, Java, XML, etc.) via a standard freely distributed web browser that does not require a Windows client software installation.

F. The communication speed between the controllers, LAN interface devices, and operator interface devices shall be sufficient to ensure fast system response time under any loading condition. Contractor shall submit guaranteed response times with shop drawings including calculations to support the guarantee. In no case shall delay times between an event, request, or command initiation and its completion be greater than those listed herein. Contractor shall recommend reconfiguring the LAN as necessary to accomplish these performance requirements.:
   1. 5 seconds between a Level 1 (critical) alarm occurrence and enunciation at operator workstation.
   2. 10 seconds between a Level 2 alarm occurrence and enunciation at operator workstation.
   3. 20 seconds between and a Level 3-5 alarm occurrence and enunciation at operator workstation.
   4. 10 seconds between an operator command via the operator interface to change a setpoint and the subsequent change in the controller.
   5. 5 seconds between an operator command via the operator interface to start/stop a device and the subsequent command to be received at the controller.
   6. 10 seconds between a change of value or state of an input and it being updated on the operator interface.
   7. 10 seconds between an operator selection of a graphic and it completely painting the screen and updating at least 10 points.

G. Control Systems Server (CSS): A server class computer(s) that maintains the systems configuration and programming database. This server is located at the State of Delaware's data center in a virtual environment and serves as an access point to BAS. It shall hold the backup files of the information downloaded into the individual controllers and as such support uploading and downloading that information directly to/from the controllers. It shall also act as a control information server to non-control system based programs. It shall allow secure multiple-access to the control information. Refer to Section 23 09 52 - BAS Operator Interfaces for its requirements.

H. The Operator Interface shall provide for overall system supervision, graphical user interface, management report generation, alarm annunciation, and remote monitoring. Refer to Section 23 09 52 - BAS Operator Interfaces.

I. The BCs, AACs, ASCs, and SDs shall monitor, control, and provide the field interface for all points specified. Each BC, AAC, or ASC shall be capable of performing all specified energy
operator interface devices as more fully specified in Section 23 09 53 - BAS Field Panels.

J. Systems Configuration Database: The system architecture shall support maintaining the systems configuration database on the CSS. User tools provided to the State shall allow configuring, updating, maintaining, etc. current configurations and settings whether they are initiated at the server or the end device.
   1. Database Schema shall be published and provided to the State to facilitate easy access to the data.

2. Database shall be ODBC compliant.

K. Interruptions or fault at any point on any Primary Controller LAN shall not interrupt communications between other nodes on the network. If a LAN is severed, two separate networks shall be formed and communications within each network shall continue uninterrupted.

L. All line drivers, signal boosters, and signal conditioners etc. shall be provided as necessary for proper data communication.

M. Anytime any controller's database or program is changed in the field, the controller shall be capable of automatically uploading the new data to the CSS.

1.12 WARRANTY MAINTENANCE

A. Contractor shall warrant all products and labor for a period of two (2) years after Substantial Completion.

B. The State reserves the right to make changes to the BAS during the warranty period. Such changes do not constitute a waiver of warranty. The Contractor shall warrant parts and installation work regardless of any such changes made by the College, unless the Contractor provides clear and convincing evidence that a specific problem is the result of such changes to the BAS.

C. At no cost to the College, during the warranty period, the Contractor shall provide maintenance services for software and hardware components as specified below:
   1. Maintenance services shall be provided for all devices and hardware specified in sections 23 09 51 through 23 09 59. Service all equipment per the manufacturer's recommendations. All devices shall be calibrated within the last month of the warranty period.
   2. Emergency Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would result in property damage or loss of comfort control shall be corrected and repaired following notification by the College to the Contractor.
      a. Response by telephone to any request for service shall be provided within two (2) hours of the College’s initial telephone request for service.
      b. In the event that the malfunction, failure, or defect is not corrected through the telephonic communication, at least one (1) hardware and software technician, trained in the system to be serviced, shall be dispatched to the College’s site within eight (8) hours of the College’s initial telephone request for such services, as specified.
   3. Normal Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would not result in property damage or loss of comfort control shall be corrected and repaired following telephonic notification by the State to the Contractor.
      a. Response by telephone to any request for service shall be provided within eight (8) working hours (contractor specified 40 hr per week normal working period)

of the College's initial telephone request for service.

telephonic communication, at least one (1) hardware and software technician, trained in the system to be serviced, shall be dispatched to the College's site within three (3) working days of the College's initial telephone request for such services, as specified.

4. Telephonic Request for Service: Contractor shall specify a maximum of three (3) telephone numbers for the College to call in the event of a need for service. At least one of the lines shall be attended at any given time at all times. Alternatively, pagers can be used for technicians trained in system to be serviced. One of the three paged technicians shall respond to every call within 15 minutes.
5. Technical Support: Contractor shall provide technical support by telephone throughout the warranty period.
6. Preventive maintenance shall be provided throughout the warranty period in accordance with the hardware component manufacturer's requirements.

1.13 DELIVERY, STORAGE, AND HANDLING

A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons during shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protect from weather.

1.14 LISTING AND LABELING

A. The BAS and components shall be listed by Underwriters Laboratories (UL 916) as an Energy Management System.

PART 2 - PRODUCTS

2.01 MANUFACTURERS (Pre-Approved by the State)

A. Automated Logic by Radius Systems

B. BuildingLogix / Lynxspring / KMC Controls by Seiberlich Trane

C. Johnson Controls by Modern Controls

D. Substitutions: See Section 01 60 00 - Product Requirements

E. The existing system is an IA Series by Schneider Electric that is installed and maintained by CM3 Building Solutions.

2.02 MATERIALS AND EQUIPMENT

A. Materials shall be new, the best of their respective kinds without imperfections or blemishes and shall not be damaged in any way. Used equipment shall not be used in any way for the permanent installation except where drawings or specs specifically allow existing materials to remain in place.

2.03 UNIFORMITY

A. To the extent practical, all equipment of the same type serving the same function shall be identical and from the same manufacturer.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF CONTROL SYSTEMS

A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings.

B. Network Connectivity: The BAS Contractor shall provide two (2) network connections with Cat-6 cables from the Building Controller to the College's IT network.
   1. The BAS Contractor shall terminate one end of the two (2) Cat-6 cables at or around the State's patch panel and make connections to the College's switch with green patch cables, following the instruction of the DFM's IT personnel.
   2. The BAS Contractor shall terminate the other end of the two (2) Cat-6 cables near or within the Building Controller cabinet with dual RJ-45 terminal box and make connection of one cable to the Building Controller. Note: the second connection is for on-site operator interface through a mobile computer. Exposed cable shall be protected by conduit or wire mold.
   3. The BAS Contractor shall label the two (2) network connections BAC-1 and BAC-2 on both ends.

C. Refer to additional requirements in other sections of this specification.

3.03 SURGE PROTECTION

A. The Contractor shall furnish and install any power supply surge protection, filters, etc. as necessary for proper operation and protection of all BCs, AAC/ASCS operator interfaces, printers, routers, gateways and other hardware and interface devices. All equipment shall be capable of handling voltage variations 10% above or below measured nominal value, with no effect on hardware, software, communications, and data storage.

3.04 CONTROL POWER SOURCE AND SUPPLY

A. Section 23 09 50 Contractor shall extend all power source wiring required for operation of all equipment and devices provided under Sections 23 09 50 through 23 09 55 and Sequences of Operation.

The following item will have to be customized for each system and project. The consideration is where to power controllers from. For distributed controllers that are

associated with one unit, it is convenient to power them along with the system so the controller can take action based on the presence of power. However on large centralized panels, it may be best to put these on the most reliable source of power that serves the equipment being controlled and then provide for individual monitoring of the various systems' power sources by the controller. The object here is to make a robust system that does not interpret power failures as device failure and therefore in some instances have to take down the unit for manual acknowledged reset. This can compromise reliability.

B. General requirements for obtaining power include the following:
   1. Obtain power from a source that feeds the equipment being controlled such that both the control component and the equipment are powered from the same panel. Where equipment is powered from a 460V source, obtain power from the electrically most proximate 120v source fed from a common origin.
   2. Where control equipment is located inside a new equipment enclosure, coordinate with the equipment manufacturer and feed the control with the same source as the equipment. If
      the equipment's control transformer is large enough and of the correct voltage to supply the controls it may be used. If the equipment's control transformer is not large enough or of the correct voltage to supply the controls provide separate transformer
   3. Where a controller controls multiple systems on varying levels of power reliability (normal, emergency, and/or interruptible), the controller shall be powered by the highest level of reliability served. Furthermore, the controller in that condition shall monitor each power type served to determine so logic can assess whether a failure is due to a power loss and respond appropriately. A three-phase monitor into a digital input shall suffice as power monitoring.
   4. Standalone Functionality: Refer to Section 23 09 53.

3.07 BAS STARTUP, COMMISSIONING AND TRAINING

A. Refer to Section 23 09 59

3.08 SEQUENCE OF OPERATION

A. Refer to Section 23 09 58 - Sequences of Operation

END OF SECTION 23 09 50

SECTION 23 09 51 - BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Wiring

B. Control Valves and Actuators

C. Control Dampers and Actuators

D. Control Panels

E. Sensors

F. Flow Meter

G. Electric Control Components (Switches, EP Valves, Thermostats, Relays, Smoke Detectors, etc.)

H. Transducers

I. Air Flow Measuring Stations

J. Current Switches

K. Nameplates

L. Testing Equipment

1.02 RELATED DOCUMENTS

A. Section 23 09 50 - Building Automation System (BAS) General

B. Section 23 09 53 - BAS Field Panels

C. Section 23 09 54 - BAS Communications Devices

D. Section 23 09 55 - BAS Software

E. Section 23 09 58 - Sequences of Operation

F. Section 23 09 59 - BAS Commissioning

1.03 DESCRIPTION OF WORK

A. Refer to Section 23 09 50 for general requirements.

B. Refer to other Division 23 sections for installation of instrument wells, valve bodies, and dampers in mechanical systems; not work of this section.

C. Provide the following electrical work of this section, complying with requirements of

Division 26 sections:

1. Control wiring between field-installed controls, indicating devices, and unit control panels.
2. Interlock wiring between electrically interlocked devices, sensors, and between a hand or auto position of motor starters as indicated for all mechanical and controls.
3. Wiring associated with indicating and alarm panels (remote alarm panels) and connections to their associated field devices.
4. All other necessary wiring for fully complete and functional control system as specified.
5. Controls contractor shall engage the services of the on-site Electrical Contractor to provide all 120 VAC circuits required for the operation of all control panels and peripheral devices on the project. Each circuit shall be fed with a new 20 ampere circuit breaker in a local panelboard and fed via 2-#12 and 1-#12 GND -3/4”C. Wiring above ceilings, in concealed spaces only may be installed with Type MC cable. Consult project electrical drawings as some circuits have been provided however it is the Contractor’s responsibility to provide additional circuits. Comply with 23 09 50.

6. Controls Contractor to provide all operators, sensors, transducers, transmitters, actuators, interfacing units or other equipment and material that is not provided with equipment such as the air handling unit, exhaust fans, fan coil unit, boilers, fan VFDs, pump VFDs and similar HVAC equipment.

1.04 WORK BY OTHERS

A. Control Valves furnished under this section shall be installed under the applicable piping section under the direction of Section 23 09 51 Contractor who will be fully responsible for the proper operation of the valve.

B. Control Dampers furnished under this section shall be installed under the applicable air distribution or air handling equipment section under the direction of Section 23 09 51 Contractor who will be fully responsible for the proper operation of the damper

C. Water Pressure Taps, Thermal Wells, Flow Switches, Flow Meters, etc. that will have wet surfaces, shall be installed under the applicable piping Section under the direction of Section 23
09 51 Contractor who will be fully responsible for the proper installation and application.

D. Controlled Equipment Power Wiring shall be furnished and installed under Division 26. Where control involves 120V control devices controlling 120V equipment, Division 26 Contractor shall extend power wiring to the equipment. Section 23 09 51 Contractor shall extend it from the equipment to the control device.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. General: Provide electronic control products in sizes and capacities indicated, consisting of valves, dampers, thermostats, clocks, controllers, sensors, and other components as required for complete installation and reviewed and approved by the State. Except as otherwise indicated, provide manufacturer's standard materials and components as

published in their product information; designed and constructed as recommended by manufacturer, and as required for application indicated.

B. Communication Wiring: All wiring shall be in accordance with National Electrical Codes and Division 26 of this specification.
   1. Contractor shall supply all communication wiring between Building Controllers, Routers, Gateways, AAC's, ASC's and local and remote peripherals (e.g., operator workstations, printers, and modems).
   2. Local Supervisory LAN: For any portions of this network required under this section of the specification, contractor shall use Fiber or Category 6 of standard TIA/EIA (100/1000BaseT). Network shall be run with no splices and separate from any wiring over thirty (30) volts.
   3. Primary and Secondary Controller LANs: Communication wiring shall be individually 100% shielded pairs per manufacturers recommendations for distances installed, with overall PVC cover, Class 2, plenum-rated run with no splices and separate from any wiring over thirty (30) volts. Shield shall be terminated and wiring shall be grounded as recommended by BC manufacturer.

C. Signal Wiring: Contractor shall run all signal wiring in accordance with National Electric Codes and Division 26 of this Specification.
   1. Signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, etc. shall be twisted, 100% shielded pair, minimum 18-gauge wire, with PVC cover. Signal wiring shall be run with no splices and separate from any wiring above thirty (30) volts.
   2. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.

D. Low Voltage Analog Output Wiring: Contractor shall run all low voltage control wiring in accordance with National Electric Codes and Division 16 of this Specification.
   1. Low voltage control wiring shall be minimum 16-gauge, twisted pair, 100% shielded, with PVC cover, Class 2 plenum-rated. Low voltage control wiring shall be run with no splices separate from any wiring above thirty (30) volts.

E. Control Panels: Provide control panels with suitable brackets for wall mounting for each control system. Locate panel adjacent to systems served.
   1. Fabricate panels of 16-gage furniture-grade steel, or 6063-T5 extruded aluminum alloy, totally enclosed on four sides, with hinged door and keyed lock, with manufacturer's standard shop- painted finish and color.
   2. Provide UL-listed cabinets for use with line voltage devices.
   3. Control panel shall be completely factory wired and piped, and all electrical connections made to a terminal strip. Control panel shall have standard manufacturer's color.
   4. All gauges and control components shall be identified by means of nameplates.

5. All control tubing and wiring shall be run neatly and orderly in open slot wiring duct with cover.
6. Complete wiring and tubing termination drawings shall be mounted in or adjacent to panel.

2.02 Control Valves (with Auto-flow Balancing)

A. General: Provide factory fabricated pressure independent characterized control valves with built in flow regulator of type, body material and pressure class indicated. Where type or body material is not indicated, provide selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature in piping system. Provide valve size in accordance with scheduled or specified maximum pressure drop across control valve. Control valves shall be equipped with heavy-duty actuators, and with proper close-off rating for each individual application. Minimum close-off rating shall be as scheduled and adequate for each application, and shall generally be considered at dead head rating of the pump.

B. Ball Type
1. Body: Forged Brass, nickel plated; threaded ends.
2. Seat: Reinforced Teflon PTFE
3. Ball: Chrome plated brass
4. Port: Standard or 'V' style.
5. Stem: Chrome plated brass
6. Cold Service Pressure: 400 psi WOG
7. Regulator components: Stainless steel/brass/Delrin 500AF
8. Spring: Stainless Steel

C. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
1. Belimo
2. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 Control Valves

A. General: Provide factory fabricated control valves of type, body material and pressure class indicated. Where type or body material is not indicated, provide selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature in piping system. Provide valve size in accordance with scheduled or specified maximum pressure drop across control valve. Control valves shall be equipped with heavy-duty actuators, and with proper close-off rating for each individual application. Minimum close-off rating shall be as scheduled and adequate for each application, and shall generally be considered at dead head rating of the pump.

B. Plug-Type Globe Pattern for Water Service:

1. Valve Sizing: Where not specifically indicated on the control drawings, modulating valves shall be sized for maximum full flow pressure drop between 50% and 100% of the branch circuit it is controlling unless scheduled otherwise. Two-position valves shall be same size as connecting piping.
2. Single Seated (Two-way) Valves: Valves shall have equal-percentage characteristic for typical heat exchanger service and linear characteristic for building loop connections to campus systems unless otherwise scheduled on the drawings. Valves shall have cage-type trim, providing seating and guiding surfaces for plug on 'top-and-bottom' guided plugs.
3. Double Seated (Three-way) Valves: Valves shall have linear characteristic. Valves shall be balanced-plug type, with cage-type trim providing seating and guiding surfaces on 'top-and-bottom' guided plugs.
4. Temperature Rating: 25°F minimum, 250°F maximum
5. Body: Bronze, screwed, 250 psi maximum working pressure for 1/2” to 2”; Cast Iron, flanged, 125 psi maximum working pressure for 2-1/2” and larger.
6. Valve Trim: Bronze; Stem: Polished stainless steel.
7. Packing: Spring Loaded Teflon or Synthetic Elastomer U-cups, self-adjusting.
8. Plug: Brass, bronze or stainless steel, Seat: Brass
9. Disc: Replaceable Composition or Stainless Steel Filled PTFE.
10. Ambient Operating Temperature Limits: -10 to 150°F (-12.2 to 66 °C)
11. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
    a. Johnson Controls
    b. Invensys
    c. Warren
    d. Delta
    e. Belimo
    f. Substitutions: See Section 01 60 00 - Product Requirements.

C. Plug-Type Globe Pattern for Steam Service:

1. Valve Sizing: Where valve size is not specifically indicated on the drawings, size modulating valves for applications of 15 psig or less for 80% of inlet gage pressure unless scheduled otherwise. Modulating valves for applications of greater than 15 psig shall be sized for 42% of inlet absolute pressure unless scheduled otherwise. Two-position valves shall be same size as connecting piping.
2. Characteristics: Modified equal-percentage characteristics. Cage-type trim, providing seating and guiding surfaces for plug on "top and bottom" guided plugs.
    a. Working Temperature: 250°F minimum for saturated steam applications of 15

psig or less; 366°F minimum for saturated steam applications of greater than 15 psig up to 150 psig.

b. Body: Bronze, screwed, 250 psig steam working pressure for 1/2” to 2”; Cast Iron, flanged, 100 psig steam working pressure for 2-1/2” and larger for applications of 50 psig or less.
c. Valve Trim, Plug, Seat and Stem: Polished stainless steel.
d. Packing: Spring Loaded Teflon.
e. Disc: Replaceable Composition or Stainless Steel Filled PTFE.
f. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
   1) Johnson Controls
   2) Invensys
   3) Warren
   4) Delta
   5) Substitutions: See Section 01 60 00 - Product Requirements.

D. Butterfly Type:
1. Body: Extended neck epoxy coated cast or ductile iron with full lug pattern, ANSI Class 125 or 250 bolt pattern to match specified flanges.
2. Seat: EPDM, except in loop bypass applications where seat shall be metal to metal
3. Disc: Bronze or stainless steel, pinned or mechanically locked to shaft
4. Bearings: Bronze or stainless steel
5. Shaft: 416 stainless steel
6. Cold Service Pressure: 175 psi
7. Close Off: Bubble-tight shutoff to 150 psi
8. Operation: Valve and actuator operation shall be smooth both seating and unseating. Should more that 2 psi deadband be required to seat/unseat the valve, valve shall be replaced at no cost to the State.
9. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
   a. Jamesbury WS815
   b. Bray Series 31
   c. Keystone R2
   d. Dezurik BGS
   e. Belimo
   f. Substitutions: See Section 01 60 00 - Product Requirements.

E. Ball Type
1. Body: Brass or bronze; one-, two-, or three-piece design; threaded ends.
2. Seat: Reinforced Teflon
3. Ball: Stainless steel.
4. Port: Standard or 'V' style.
5. Stem: Stainless steel, blow-out proof design, extended to match thickness of insulation.
6. Cold Service Pressure: 600 psi WOG

7. Steam working Pressure: 150 psi
8. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
   a. Conbraco
   b. Worcester
   c. Nibco
   d. Jamesbury
   e. PBM
   f. Delta
   g. Belimo
   h. Substitutions: See Section 01 60 00 - Product Requirements

F. Segmented or Characterized Ball Type
1. Body: Carbon Steel (ASTM 216), one-piece design with wafer style ends.
2. Seat: Reinforced Teflon (PTFE).
3. Ball: Stainless steel ASTM A351
4. Port: Segmented design with equal-percentage characteristic.
5. Stem: Stainless steel.
6. Cold Service Pressure: 200 psi WOG
7. Cavitation Trim: Provide cavitation trim where indicated and/or required, designed to eliminate cavitation and noise while maintaining an equal percentage characteristic. Trim shall be a series of plates with orifices to break the pressure drop into multi-stages.
8. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
   a. Jamesbury R-Series
   b. Fisher
   c. Belimo
   d. Substitutions: See Section 01 60 00 - Product Requirements

2.04 Control Dampers

A. General: Provide factory fabricated automatic control dampers of sizes, velocity and pressure classes as required for smooth, stable, and controllable air flow. Provide parallel or opposed blade dampers as recommended by manufacturers sizing techniques. For dampers located near fan outlets, provide dampers rated for fan outlet velocity and close-off pressure, and recommended by damper manufacturer for fan discharge damper service. Control dampers used for smoke dampers shall comply with UL 555S. Control Dampers used for fire dampers shall comply with UL 555.

B. For general isolation and modulating control service in rectangular ducts at velocities not greater than 1500 fpm (7.62 m/s), differential pressure not greater than 2.5” w.c. (622 Pa):
1. Performance: Test in accordance with AMCA 500.
2. Frames: Galvanized steel, 16-gauge minimum thickness, welded or riveted with corner reinforcement.

3. Blades: Stainless steel in lab exhausts and galvanized steel elsewhere, maximum blade size 8 inches (200 mm) wide by 48 inches (1219 mm) long, attached to minimum 1/2 inch (12.7 mm) shafts with set screws, 16 gauge minimum thickness.
4. Blade Seals: Synthetic elastomer, mechanically attached, field replaceable.
5. Jamb Seals: Stainless steel.
6. Shaft Bearings: Oil impregnated sintered bronze, graphite impregnated nylon sleeve or other molded synthetic sleeve, with thrust washers at bearings.
7. Linkage: Concealed in frame.
8. Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.
9. Leakage: Less than one percent based on approach velocity of 1500 ft./min. (7.62 m/s) and 1 inches wg. (249Pa).
10. Maximum Pressure Differential: 2.5 inches wg. (622 Pa)
11. Temperature Limits: -40 to 200 °F (-40 to 93 °C).
12. Where opening size is larger than 48 inches (1219 mm) wide, or 72 inches (1829 mm) high, provide dampers in multiple sections, with intermediate frames and jackshafts appropriate for installation.

C. For general isolation and modulating control service in rectangular ducts at velocities not greater than 4000 fpm (20.3 m/s), differential pressure not greater than 6” w.c. (1493 Pa):
1. Performance: Test in accordance with AMCA 500.
2. Frames: Galvanized steel, 16-gauge minimum thickness, welded or riveted with corner reinforcement.
3. Blades: extruded aluminum hollow airfoil shape, maximum blade size 8 inches (200 mm) wide by 48 inches (1219 mm) long, attached to minimum 1/2 inch (12.7 mm) shafts, 14 gauge minimum extrusion thickness.
4. Blade Seals: Synthetic elastomeric, mechanically attached, field replaceable.
5. Jamb Seals: Stainless steel.
6. Shaft Bearings: Oil impregnated sintered bronze sleeve, graphite impregnated nylon sleeve, molded synthetic sleeve, or stainless steel sleeve, with thrust washers at bearings.
7. Linkage: Concealed in frame.
8. Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.
9. Leakage: Less than 0.1 percent based on approach velocity of 4000 ft./min. (20.3 m/s) and 1 inches wg. (249Pa).
10. Maximum Pressure Differential: 6 inches wg. (622 Pa)
11. Temperature Limits: -40 to 200 °F (-40 to 93 °C)
12. Where opening size is larger than 48 inches (1219 mm) wide, or 72 inches (1829 mm) high, provide dampers in multiple sections, with appropriately intermediate frames, and jackshafts.

D. For general isolation and modulating control service in rectangular ducts at velocities not greater than 4000 fpm, differential pressure not greater than 12” w.c.:
1. Performance: Test in accordance with AMCA 500.
2. Frames: Galvanized steel, 12-gauge minimum thickness, welded or riveted with

corner reinforcement.

3. Blades: Extruded aluminum hollow airfoil shape, maximum blade size 8 inches (200 mm) wide by 48 inches (1219 mm) long, attached to minimum 3/4 inch (19 mm) shafts with set screws
4. Shaft Bearings: Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.
5. Linkage: 10-gauge minimum thickness galvanized steel clevis type crank arms, 3/16" x3/4" (4.76 mm x 19 mm) minimum thickness tie rods.
6. Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.
7. Leakage: Less than 0.2 percent based on approach velocity of 4000 ft./min. (20.3 m/s) and 1 inches wg. (249Pa) differential pressure.
8. Maximum Pressure Differential: 12 inches wg. (2984 Pa)
9. Temperature Limits: -40 to 300 °F (-40 to 149 °C).
10. Where opening size is larger than 48 inches (1219 mm) wide, or 72 inches (1829 mm) high, provide dampers in multiple sections, with appropriately intermediate frames, and jackshafts.

E. For general isolation and modulating control service in round ducts up to 40 inches in size at velocities not greater than 2500 fpm (12.7 m/s), differential pressure not greater than 4" w.c. (994 Pa):
1. Performance: Test in accordance with AMCA 500.
2. Frames: rolled 12 gauge steel strip for sizes 6 inch and smaller, rolled 14 gauge steel channel for larger sizes, galvanized or aluminum finish.
3. Blades: Steel construction, 12 gauge minimum thickness for dampers less than 18 inches (457 mm) in size, 10 gauge minimum thickness for larger dampers.
4. Blade Seals: Full circumference neoprene.
5. Shaft: ½ inch (12.7 mm) diameter zinc or cadmium plated steel.
6. Shaft Bearings: Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.
7. Leakage: Less than 0.2 percent based on approach velocity of 4000 ft./min. (20.3 m/s) and 1 inches wg. (249Pa) differential pressure.
8. Maximum Pressure Differential: 4 inches wg. (994 Pa)
9. Temperature Limits: -40 to 300 °F (-40 to 149 °C).

F. For general isolation and modulating control service in round ducts up to 60 inches in size at velocities not greater than 4000 fpm (20.3 m/s), differential pressure not greater than 6" w.c. (1492 Pa):
1. Performance: Test in accordance with AMCA 500.
2. Frames: rolled 10-gauge steel channel for sizes 48 inch and smaller, rolled 3/16 inch (4.76 mm) thick steel channel for larger sizes, galvanized or aluminum finish.
3. Blades: Steel construction, 10-gauge minimum thickness for dampers not greater than 48 inches in size, ¼ inch (6.35 mm) minimum thickness for larger dampers.
4. Blade stops: ½ inch x ¼ inch (12.7 mm x 6.35 mm) full circumference steel bar.
5. Blade Seals: Full circumference neoprene.
6. Shaft: zinc or cadmium plated steel, angle reinforcing as necessary.

7. Shaft Bearings: Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.
8. Leakage: Less than 0.4 percent based on approach velocity of 4000 ft./min. (20.3 m/s) and 1 inches wg. (249Pa) differential pressure.
9. Maximum Pressure Differential: 6 inches wg. (1492 Pa)
10. Temperature Limits: -40 to 250 °F (-40 to 121 °C).

2.05 ACTUATORS

A. General: Size actuators and linkages to operate their appropriate dampers or valves with sufficient reserve torque or force to provide smooth modulating action or 2-position action as specified. Select spring-return actuators with manual override to provide positive shut-off of devices as they are applied.

B. Damper Actuators
1. Ambient Operating Temperature Limits: -10 to 150°F (-12.2 to 66 °C)
2. Two Position Electric Actuators: Line voltage with spring return
3. Electronic Actuators: Provide actuators with spring return for two-position (24v), 0-5 Vdc, 0-10 Vdc, 2-10Vdc, 4-20 mA, or PWM input (subject to restrictions) as required. Actuators shall travel full stroke in less than [90] seconds. Actuators shall be designed for a minimum of 60,000 full cycles at full torque and be UL 873 listed. Provide stroke indicator. Actuators shall have positive positioning circuit. Where two actuators are required in parallel or in sequence provide an auxiliary actuator driver. Actuators shall have current limiting motor protection. Actuators shall have manual override where indicated. Modulating actuators for valves shall have minimum rangeability of 40 to 1.
   a. Close-Off Pressure: Provide the minimum torque required, and spring return for fail positioning (unless otherwise specifically indicated) sized for required close-off pressure. Required close-off pressure for two-way water valve applications shall be the shutoff head of associated pump. Required close-off rating of steam valve applications shall be design inlet steam pressure plus 50 percent for low pressure steam, and 10 percent for high pressure steam. Required close-off rating of air damper applications shall be shutoff pressure of associated fan, plus 10 percent.
   b. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
      1) Belimo
      2) Johnson Controls
      3) Delta
      4) Invensys
      5) Substitutions: See Section 01 60 00 - Product Requirements

C. Quarter-Turn Actuators (for ball and butterfly valves):
1. Electric
   a. Motor: Suitable for 120 or 240 Volt single-phase power supply. Insulation shall be NEMA Class F or better. Motor shall be rated for 100 percent duty cycle. Motors shall have inherent overload protection.

b. Gear Train. Motor output shall be directed to a self locking gear drive mechanism. Gears shall be rated for torque input exceeding motor locked rotor torque.
c. Wiring: Power and control wiring shall be wired to a terminal strip in the actuator enclosure
d. Failsafe Positioning: Actuators shall be spring return type for failsafe positioning.
e. Enclosure: Actuator enclosure shall be NEMA-4 rated, and shall have a minimum of two threaded conduit entries. Provide an enclosure heater for actuators located outside of buildings.
f. Limit Switches: Travel limit switches shall be UL and CSA approved. Switches shall limit actuator in both open and closed positions.
g. Mechanical Travel Stops: The actuator shall include mechanical travel stops of stainless steel construction to limit actuator to specific degrees of rotation.
h. Manual Override: Actuators shall have manual actuator override to allow operation of the valve when power is off. For valves 4 inches and smaller the override may be a removable wrench or lever or geared handwheel type. For larger valves, the override shall be a fixed geared handwheel type. An automatic power cut-off switch shall be provided to disconnect power from the motor when the handwheel is engaged for manual operation.
i. Valve Position Indicator: A valve position indicator with arrow and open and closed position marks shall be provided to indicate valve position.
j. Torque Limit Switches: Provide torque limit switches to interrupt motor power when torque limit is exceeded in either direction of rotation.
k. Position Controller: For valves used for modulating control, provide an electronic positioner capable of accepting 4-20 mA, 0-10 Vdc, 2-10 Vdc, and 135 Ohm potentiometer.
l. Ambient Conditions: Actuator shall be designed for operation from -140 to 150 °F ambient temperature with 0 to 100 percent relative humidity.

2.06 GENERAL FIELD DEVICES

A. Provide field devices for input and output of digital (binary) and analog signals into controllers (BCs, AACs, ASCs). Provide signal conditioning for all field devices as recommended by field device manufacturers, and as required for proper operation in the system.

B. It shall be the Contractor's responsibility to assure that all field devices are compatible with controller hardware and software.

C. Field devices specified herein are generally 'two-wire' type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power, or is not designed to work with 'two-wire' type transmitters, or if field device is to
serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, the Contractor shall provide 'four-wire' type equal transmitter and necessary regulated DC power supply or 120 VAC power supply, as

required.

D. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, Contractor shall furnish and install proper device, including 120V power as required. Such devices shall have accuracy equal to, or better than, the accuracy listed for respective field devices.

E. Accuracy: As stated in this Section, accuracy shall include combined effects of nonlinearity, nonrepeatability and hysteresis.

2.07 TEMPERATURE SENSORS (TS)

A. Sensor range: When matched with A/D converter of BC, AAC/ASC, or SD, sensor range shall provide a resolution of no worse than 0.3°F (0.16 °C) (unless noted otherwise). Where thermistors are used, the stability shall be better than 0.25°F over 5 years.

B. Matched Sensors: The following applications shall require matched sensors:
   1. Building Loop Connections: Provide matched loop and building supply sensors where control sequence requires controlling to a temperature rise (differential).
   2. Hydronic Temperature Difference Calculations: Provide matched supply and return temperature sensors where the pair is used for calculating temperature difference for use in load calculations or sequencing such as across chillers and plants.
   3. Air Handling Unit Sequencing: Provide matched pair for the cooling and heating coil leaving sensors where the sequence includes calculating an offset from the supply air setpoint to maintain a leaving heating coil temperature.

C. Room Temperature Sensor: Shall be an element contained within a ventilated cover, suitable for wall mounting. Provide insulated base. Following sensing elements are acceptable:
   1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 0.4°F accuracy at calibration point.
   2. Provide setpoint adjustment where indicated. The setpoint adjustment shall be a warmer/cooler indication that shall be scalable via the BAS.
   3. Provide an occupancy override button on the room sensor enclosure where indicated. This shall be a momentary contact closure
   4. Provide current temperature indication via an LCD or LED readout where indicated.

D. Single-Point Duct Temperature Sensor: Shall consist of sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise. Temperature range as required for resolution indicated in paragraph A. Sensor probe shall be 304 stainless steel.
   1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 0.2°F accuracy at calibration point

E. Averaging Duct Temperature Sensor: Shall consist of an averaging element, junction box for wiring connections and gasket to prevent air leakage. Provide sensor lengths and quantities to result in one lineal foot of sensing element for each three square feet of cooling coil/duct face area. Temperature range as required for resolution indicated in

paragraph A.

1. Sensing element shall be platinum RTD, or thermistor, +/- 0.2°F accuracy at calibration point.

F. Liquid immersion temperature sensor shall include [brass] thermowell, sensor and connection head for wiring connections. Temperature range shall be as required for resolution of 0.15°F.
   1. Sensing element (chilled water/glycol systems) shall be platinum RTD +/- 0.2°F accuracy at calibration point. Temperature range shall be as required for resolution of 0.15°F.
   2. Sensing element (other systems) shall be platinum RTD, thermistor, or integrated circuit, +/- 0.4°F accuracy at calibration point. Temperature range shall be as required for resolution of 0.3°F.

G. Pipe Surface-Mount Temperature Sensor: Shall include metal junction box and clamps and shall be suitable for sensing pipe surface temperature and installation under insulation. Provide thermally conductive paste at pipe contact point. Temperature range shall be as require for resolution indicated in paragraph A.
   1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 0.4°F accuracy at calibration point.

H. Outside air sensors shall consist of a sensor, sun shield, utility box, and watertight gasket to prevent water seepage. Temperature range shall be as require for resolution indicated in Paragraph A
   1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 0.4°F accuracy at calibration point.

2.08 Temperature Transmitters

A. Where required by Controller, or where wiring runs are over 50 feet, sensors as specified above may be matched with transmitters outputting 4-20 mA linearly across the specified temperature range. Transmitters shall have zero and span adjustments, an accuracy of 0.1°F when applied to the sensor range.

2.09 HUMIDITY TRANSMITTERS

A. Units shall be suitable for duct, wall (room) or outdoor mounting. Unit shall be two-wire transmitter utilizing bulk polymer resistance change or thin film capacitance change humidity sensor. Unit shall produce linear continuous output of 4-20 mA for percent relative humidity (% RH). A combination temperature and humidity sensor may be used for zone level monitoring. Sensors shall have the following minimum performance and application criteria:

   1. Input Range: 0 to 100% RH.
   2. Accuracy(% RH): +/- 2% (when used for enthalpy calculation, dewpoint calculation or humidifier control) or +/- 3% (monitoring only) between 20-90% RH at 77°F, including hysteresis, linearity, and repeatability.
   3. Sensor Operating Range: As required by application

4. Long Term Stability: Less than 1% drift per year.

B. Acceptable Manufacturers: Units shall be Vaisala HM Series, General Eastern, Microline, or Hy-Cal HT Series. Substitutions shall be allowed per Division 1.

2.10 DIFFERENTIAL PRESSURE TRANSMITTERS (DP)

A. General Purpose - Water: Two-wire transmitter, 4-20 mA output with zero and span adjustments. Plus or minus 0.5% overall accuracy, 450 psig (3103 KPa) maximum static pressure rating, 200 psid maximum overpressure rating for 6 through 60 psid range, 450 psid for
100 through 300 psid range. Acceptable units shall be Kele & Associates Model 360 C. Substitutions shall be allowed per Division 1.

B. Industrial Application, Liquid, Steam and Gas:
1. General: Two-wire smart DP cell type transmitter, 4-20 mA or 1-5 Vdc user-selectable linear or square root output, adjustable span and zero, stainless steel wetted parts.
2. Environmental limits: -40 to 250 °F (-40 to 121°C), 0 to 100% RH..
3. Accuracy: less than 0.1 percent of span.
4. Output Damping: Time constant user selectable from 0 to 36 seconds.
5. Vibration Effect: Less than ±0.1% of upper range limit from 15 to 2000 Hz in any axis relative to pipe mounted process conditions.
6. Electrical Enclosure: NEMA-4, -4X, -7, -9.
7. Approvals: FM, CSA.
8. Acceptable Manufacturers: Rosemount Inc. 3051 Series, Foxboro, Johnson-Yokagawa, Setra, or Mamac. Substitutions shall be allowed per Division 1.

C. General Purpose Low Pressure Air: Generally for use in static measurement of duct pressure or constant volume air velocity pressure measurement where the range is applicable.
1. General: Loop powered two-wire differential capacitance cell-type transmitter.
2. Output: two wire 4-20 mA output with zero adjustment.
3. Overall Accuracy: Plus or minus 1%.
4. Minimum Range: 0.1 in. w.c.
5. Maximum Range: 10 inches w.c.
6. Housing: Polymer housing suitable for surface mounting.
7. Acceptable Manufacturers: Modus T30. Substitutions shall be allowed per Division 1.
8. Static Sensing Element: Pitot-type static pressure sensing tips similar to Dwyer model A-301 and connecting tubing.
9. Range: Select for specified setpoint to be between 25% and 75% full-scale.

D. General Purpose Low Pressure/Low Differential Air: Generally for use in static measurement of space pressure or constant volume air velocity pressure measurement where the range is applicable.
1. General: Loop powered, two-wire differential capacitance cell type transmitter.
2. Output: Two-wire 4-20 mA output with zero adjustment.

3. Overall Accuracy: Plus or minus 1%.
4. Minimum Range: 0 in. w.c.
5. Maximum Range: 0.1, 0.25, or 0.5 inches w.c.
6. Housing: Polymer housing suitable for surface mounting.
7. Acceptable Manufacturers: Modus T30. Substitutions shall be allowed per Division 1.
8. Static Sensing Element: Pitot-type static pressure sensing tips similar to Dwyer model A-301 and connecting tubing.
9. Range: Select for specified setpoint to be between 25% and 75% full-scale.

E. VAV Velocity Pressure: Generally for use in variable volume air velocity pressure measurement where the range is applicable.
1. General: Loop powered two-wire differential capacitance cell type transmitter.
2. Output: Two-wire, 4-20 mA output with zero adjustment.
3. Overall Accuracy: Plus or minus 0.25%
4. Minimum Range: 0 in. w.c.
5. Maximum Range: 1 inch w.c.
6. Housing: Polymer housing suitable for surface mounting.
7. Acceptable Manufacturers: Setra. Substitutions shall be allowed per Division 1.
8. Range: Select for minimum range that will accept the maximum velocity pressure expected.

2.11 Valve Bypass for Differential Pressure Sensors

A. Provide a five valve bypass kit for protection of DP sensors where the static on the pipe can cause on over pressure when connected to one port with the other at atmospheric pressure. Kit shall include high and low pressure isolation valves, high and low pressure vent valves, and a bypass valve contained in a NEMA-1 enclosure.

2.12 DIFFERENTIAL PRESSURE SWITCHES (DPS)

A. General Service - Air: Diaphragm with adjustable setpoint and differential and snap acting form C contacts rated for the application. Provide manufacturer's recommended static pressure sensing tips and connecting tubing

B. General Service - Water: Diaphragm with adjustable setpoint, 2 psig or adjustable differential, and snap-acting Form C contacts rated for the application. 60 psid minimum pressure differential range. 0°F to 160°F operating temperature range.

2.13 PRESSURE SWITCHES (PS)

A. Diaphragm or bourdon tube with adjustable setpoint and differential and snap-acting Form C contacts rated for the application. Pressure switches shall be capable of withstanding 150% of rated pressure.

B. Acceptable Manufacturers: Square D, ITT Neo-Dyn, ASCO, Penn, Honeywell, and Johnson Controls. Substitutions shall be allowed per Division 1.

2.14 TRANSDUCERS

A. Standard Capacity Electronic-to-Pneumatic (E-P) Transducers: E-P transducers shall be Voltage-to-Pneumatic (V-P) type, Current-to-Pneumatic (I-P) type, [and Pulse Width Modulated-to-Pneumatic (PWM-P) type]:
   1. Electrical Power Supply: 24 Vac or 24 Vdc.
   2. Pneumatic Air Supply: 30 psig (2.07 bar) maximum.
   3. Air Capacity: 1100 scim @ 20 psig (300 cm3/sec @ 1.4 bar).
   4. Air Consumption: Zero at steady state.
   5. Output Span: 0-20 psig (0-1.4 bar).
   6. Input: 4-20 mA, 0-5 Vdc, 1-5 Vdc, 0-10 Vdc, 2-10 Vdc, 0-15 Vdc, or 3-15 Vdc input. [Pulse width modulated or tri-state input shall be allowed].
   7. Pulse Width Modulated and Tri-state Input Time Base: Dip switch selectable
   8. Enclosure: Polymer designed for surface or panel mount.
   9. Air Connections: ¼" (6.35 mm) barbed.
   10. Failure Mode on Power Loss: Non-failsafe transducers shall have no output air loss. Failsafe transducers shall exhaust output upon power loss.
   11. Acceptable Manufacturers: RE Technologies Model UCP-522. Substitutions shall be allowed per Division 1.

B. Binary to Analog Transducers ([Pulse Width Modulating] or Tri-State-to-Voltage or -Current):
   1. Adjustable zero and span.
   2. Failure Mode on Power Loss: Shall be provided with memory feature to allow the transducer to return to last value on power failure.
   3. Accuracy: ± 1% of span
   4. Output Span: 4-20 mA, 0-5 Vdc, 1-5 Vdc, 0-10Vdc, 2-10Vdc, 0-15Vdc, 3-15Vdc
   5. Input: 4-20 mA, pulse width modulated or tri-state input.
   6. Pulse Width Modulated] and Tri-state Input Time Base: Dip switch selectable.
   7. Enclosure: Polymer designed for surface or panel mount.
   8. Failure Mode on Power Loss: Non-failsafe transducers shall have no output air loss. Failsafe transducers shall exhaust output upon power loss.
   9. Acceptable Manufacturers: RE Technologies Model PWA Series. Substitutions shall be allowed per Division 1.

C. Electronic-to Electronic (Voltage or Current to Current or Voltage):
   1. Adjustable zero and span.
   2. Failure Mode on Power Loss: Memory feature to allow the transducer to return to last value on power failure.
   3. Accuracy: ± 1% of span.
   4. Output Span: 4-20 mA, 0-5 Vdc, 1-5 Vdc, 0-10 Vdc, 2-10 Vdc, 0-15 Vdc, 3-15 Vdc.
   5. Input: 0-20 Vdc, 0-20 ma, 0-10 kOhm.
   6. Pulse Width Modulated] and Tri-state Input Time Base: Dip switch selectable
   7. Enclosure: Polymer enclosure designed for surface or panel mount.
   8. Acceptable Manufacturers: RE Technologies Model PWA Series. Substitutions shall be allowed per Division 1.

2.15 Current Switches (CS)

A. Clamp-On or Solid-Core Design Current Operated Switch (for Constant Speed Motor Status Indication)
   1. Range: 1.5 to 150 amps.
   2. Trip Point: Adjustable.
   3. Switch: Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage.
   4. Lower Frequency Limit: 6 Hz.
   5. Trip Indication: LED
   6. Approvals: UL, CSA
   7. Max. Cable Size: 350 MCM
   8. Acceptable Manufacturers: Veris Industries H-708/908; Inc., RE Technologies SCS1150A-LED. Substitutions shall be allowed per Division 1.

B. Clamp-on or Solid-Core Wire Through Current Switch (CS/CR) (for Constant Speed Motors): Same as CS with 24v command relay rated at 5A @ 240 Vac resistive, 3A @ 240 Vac inductive, load control contact power shall be induced from monitored conductor (minimum conductor current required to energize relay 5A, max. rating of 135A). Acceptable Manufacturers shall be Veris Industries, Inc., Model # H938/735; or RE Technologies RCS 1150. Substitutions shall be allowed per Division 1.
   1. Where used for single-phase devices, provide the CS/CR in a self-contained unit in a housing similar with override switch to Kele RIBX. Substitutions shall be allowed per Division 1.

C. Clamp-On Design Current Operated Switch for Variable Speed Motor Status Indication
   1. Range: 1.5 to 135 Amps.
   2. Trip Point: Self-calibrating based on VA memory associated with frequency to detect loss of belt with subsequent increase of control output to 60 Hz.
   3. Switch: Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage.
   4. Frequency Range: 5-75 Hz
   5. Trip Indication: LED
   6. Approvals: UL, CSA
   7. Max. Cable Size: 350 MCM
   8. Acceptable Manufacturers: Veris Industries, Inc. H-904. Substitutions shall be allowed per Division 1.

D. Clamp-On Wire Through Current Switch (CS/CR) (for Variable Speed Motors): Same as CS with 24v command relay rated at 5A @ 240 Vac resistive, 3A @ 240 Vac inductive, load control contact power shall be induced from monitored conductor (minimum conductor current required to energize relay 5A, max. rating of 135A). Acceptable manufacturer shall be Veris Industries, Inc., Model # H934. Substitutions shall be allowed per Division 1.

E. Variable Speed Status: Where current switches are used to sense the status for variable speed devices, the CT shall include on-board VA/Hz memory to allow distinction between a

belt break and subsequent ramp up to 60 Hz, versus operation at low speed. The belt break scenario shall be indicated as a loss of status and the operation at low speed shall indicate normal status.

2.16 CURRENT TRANSFORMERS (CT)

A. Clamp-On Design Current Transformer (for Motor Current Sensing)
   1. Range: 1-10 amps minimum, 20-200 amps maximum
   2. Trip Point: Adjustable
   3. Output: 0-5 VDC.
   4. Accuracy: ±0.2% from 20 to 100 Hz.
   5. Acceptable Manufacturers: KELE SA100. Substitutions shall be allowed per Division 1.

2.17 OUTDOOR AIR STATIC PRESSURE SENSING TIP

A. Pressure sensor: Pressure sensing tip shall be designed to minimize the effects of wind and resulting velocity pressure up to 80 mph. Acceptable manufacturers shall be Dwyer A-306. Substitutions shall be allowed per Division 1.

B. Low Air Pressure Surge Dampener: 30-second time constant. Acceptable manufacturer shall be Modus SD030. Substitutions shall be allowed per Division 1.

2.18 CONTINUOUS LEVEL TRANSMITTERS

A. Capacitance Type
   1. Provide a loop powered, continuous capacitance type level transmitter with adjustable span and zero.
   2. Output: 4-20 mA.
   3. Probe: Fluoropolymer coated stainless steel rod or cable. Provide cable probe with end attachment hardware or weight.
   4. Electrical Enclosure: NEMA-4, -7.
   5. Approvals: UL or CSA.
   6. Accuracy: ±1% of calibrated span.
   7. Process Connection: MPT or ANSI Flange as required.
   8. Acceptable Manufacturers: Drexelbrook, Endress & Hauser. Substitutions shall be allowed per Division 1.

B. Hydrostatic Pressure
   1. Two wire smart d/p cell type transmitter
   2. 4-20 mA or 1 to 5 volt user selectable linear or square root output
   3. Adjustable span and zero
   4. Stainless steel wetted parts
   5. Environmental limits: -40 to 250 °F (-40 to 121°C), 0 to 100% RH
   6. Accuracy: less than 0.1 percent of span
   7. Output Damping: time constant user selectable from 0 to 36 seconds
   8. Vibration Effect: Less than ±0.1% of upper range limit from 15 to 2000 Hz in any axis relative to pipe mounted process conditions.

9. Electrical Enclosure: NEMA 4, 4X, 7, 9
10. Approvals: FM, CSA
11. Acceptable Manufacturers: Rosemount Inc. 3051 Series, Foxboro, and Johnson-Yokagawa. Substitutions shall be allowed per Division 1.

2.19 AIRFLOW MEASURING STATIONS (AFMS)

A. Airflow measurement is supplied by equipment manufacturers.
   a. Air Handling unit outside air, return air and supply air sensor factory installed in unit.
   b. VAV box airflow/volume sensor is an integral part of the VAV box assembly.

2.20 Air Velocity Pressure Sensors (Insertion Type)

A. Single or Multi-Point Averaging (as indicated): Sensing tip shall be for insertion into duct with mounting flange and push on tube connections. Material shall be suitable to the application.

2.21 ELECTRIC CONTROL COMPONENTS

A. Limit Switches (LS): Limit switches shall be UL listed, SPDT or DPDT type, with adjustable trim arm. Limit switches shall be as manufactured by Square D, Allen Bradley. Substitutions shall be allowed per Division 1.

B. Electric Solenoid-Operated Pneumatic Valves (EP): EP valves shall be rated for a minimum of 1.5 times their maximum operating static and differential pressure.. Valves shall be ported 2-way, 3-way, or 4-way and shall be normally closed or open as required by the application. EPs shall be sized for minimum pressure drop, and shall be UL and CSA listed. Furnish and install gauges on all inputs of EPs. Furnish an adjustable air pressure regulator on input side of solenoid valves serving actuators operating at greater than 30 psig.
   1. Coil Enclosure: Indoors shall be NEMA-1, Outdoors and NEMA-3, 4, 7, 9.
   2. Fluid Temperature Rating: Valves for compressed air and cold water service shall have 150 °F (66 °C) minimum rating. Valves for hot water or steam service shall have fluid temperature rating higher than the maximum expected fluid temperature.
   3. Acceptable Manufacturers: EP valves shall be as manufactured by ASCO or Parker. Substitutions shall be allowed per Division 1.
   4. Coil Rating: EP valves shall have appropriate voltage coil rated for the application (i.e., 24 VAC, 120 VAC, 24 VDC, etc.).

C. Low Temperature Detector ('Freezestat') (FZ): Low temperature detector shall consist of a 'cold spot' element which responds only to the lowest temperature along any one foot of entire element, minimum bulb size of 1/8" x 20' (3.2mm x 6.1m), junction box for wiring connections and gasket to prevent air leakage or vibration noise, DPST (4 wire, 2 circuit) with manual reset. Temperature range 15 to 55°F (-9.4 to 12.8°C), factory set at 38°F.

D. High Temperature Detectors ('Firestat') (FS): High temperature detector shall consist of 3-pole contacts, a single point sensor, junction box for wiring connections and gasket to

prevent air leakage of vibration noise, triple-pole, with manual reset. Temperature range 25 to 215°F (-4 to
102°C).

E. Surface-Mounted Thermostat: Surface-mounted thermostat shall consist of SPDT contacts, operating temperature range of 50 to 150° F (10 to 65°C) , and a minimum 10°F fixed setpoint differential.

F. Low Voltage Wall Thermostat: Wall-mounted thermostat shall consist of SPDT sealed mercury contacts, operating temperature range of 50 to 90°F (10 to 32°C), switch rating of 24 Vac (30 Vac max.), and both manual and automatic fan operation in both the heat and cool modes.

G. Control Relays: All control relays shall be UL listed, with contacts rated for the application, and mounted in minimum NEMA-1 enclosure for indoor locations, NEMA-4 for outdoor locations.
   1. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:
      a. AC coil pull-in voltage range of +10%, -15% or nominal voltage.
      b. Coil sealed volt-amperes (VA) not greater than four (4) VA.
      c. Silver cadmium Form C (SPDT) contacts in a dustproof enclosure, with 8 or 11 pin type plug.
      d. Pilot light indication of power-to-coil and coil retainer clips.
      e. Coil rated for 50 and 60 Hz service.
      f. Acceptable Manufacturers: Relays shall be Potter Brumfield, Model KRPA. Substitutions shall be allowed per Division 1.
      g. Relays used for across-the-line control (start/stop) of 120V motors, 1/4 HP, and 1/3 HP, shall be rated to break minimum 10 Amps inductive load. Relays shall be IDEC. Substitutions shall be allowed per Division 1.

      h. Relays used for stop/start control shall have low voltage coils (30 VAC or less), and shall be provided with transient and surge suppression devices at the controller interface.

H. General Purpose Power Contactors: NEMA ICS 2, AC general-purpose magnetic contactor. ANSI/NEMA ICS 6, NEMA type 1enclosure. Manufacturer shall be Square 'D', Cutler-Hammer or Westinghouse.

I. Control Transformers: Furnish and install control transformers as required. Control transformers shall be machine tool type, and shall be US and CSA listed. Primary and secondary sides shall be fused in accordance with the NEC. Transformer shall be proper size for application, and mounted in minimum NEMA-1 enclosure.
   1. Transformers shall be manufactured by Westinghouse, Square 'D', or Jefferson. Substitutions shall be allowed per Division 1.

J. Time Delay Relays (TDR): TDRs shall be capable of on or off delayed functions, with

adjustable timing periods, and cycle timing light. Contacts shall be rated for the application with a minimum of two (2) sets of Form C contacts, enclosed in a dustproof enclosure.

1. TDRs shall have silver cadmium contacts with a minimum life span rating of one million operations. TDRs shall have solid state, plug-in type coils with transient suppression devices.
2. TDRs shall be UL and CSA listed, Crouzet type. Substitutions shall be allowed per Division
   1.

K. Electric Push Button Switch: Switch shall be momentary contact, oil tight, push button, with number of N.O. and/or N.C. contacts as required. Contacts shall be snap-action type, and rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen Bradley. Substitutions shall be allowed per Division 1.

L. Pilot Light: Panel-mounted pilot light shall be NEMA ICS 2 oil tight, transformer type, with screw terminals, push-to-test unit, LED type, rated for 120 VAC. Unit shall be 800T type, as manufactured by Allen-Bradley. Substitutions shall be allowed per Division 1.

M. Alarm Horn: Panel-mounted audible alarm horn shall be continuous tone, 120 Vac Sonalert solid-state electronic signal, as manufactured by Mallory. Substitutions shall be allowed per Division 1.

N. Electric Selector Switch (SS): Switch shall be maintained contact, NEMA ICS 2, oil-tight selector switch with contact arrangement, as required. Contacts shall be rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen-Bradley. Substitutions shall be allowed per Division 1.

2.22 NAMEPLATES

A. Provide engraved phenolic or micarta nameplates for all equipment, components, and field devices furnished. Nameplates shall be 1/8 thick, black, with white center core, and shall be minimum 1" x 3", with minimum 1/4" high block lettering. Nameplates for devices smaller than
1" x 3" shall be attached to adjacent surface.

B. Each nameplate shall identify the function for each device.

2.23 TESTING EQUIPMENT

A. Contractor shall test and calibrate all signaling circuits of all field devices to ascertain that required digital and accurate analog signals are transmitted, received, and displayed at system operator terminals, and make all repairs and recalibrations required to complete test. Contractor shall be responsible for test equipment required to perform these tests and calibrations. Test equipment used for testing and calibration of field devices shall be at least twice as accurate as respective field device (e.g., if field device is +/-0.5% accurate, test equipment shall be +/-0.25% accurate over same range).

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF CONTROL SYSTEMS

A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings. Install electrical components and use electrical products complying with requirements of National Electric Code and all local codes.

B. Control Wiring: The term "control wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connection of electric control devices.

1. Wiring System: Install complete wiring system for electric control systems. Conceal wiring except in mechanical rooms and areas where other conduit and piping are exposed. Installation of wiring shall generally follow building lines. Install in accordance with National Electrical Code and Division 16 of this Specification. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.
2. Control Wiring Conductors: Install control wiring conductors, without splices between terminal points, color-coded. Install in neat workmanlike manner, securely fastened. Install in accordance with National Electrical Code and Division 16 of this Specification.
3. Communication wiring, signal wiring and low voltage control wiring shall be installed separate from any wiring over thirty (30) volts. Signal wiring shield shall be grounded at controller end only, unless otherwise recommended by the controller manufacturer.
4. All WAN and LAN Communication wiring shield shall be terminated as recommended by controller manufacturer. All WAN and LAN Communication wiring shall be labeled with a network number, device ID at each termination and shall correspond with the WAN and LAN system architecture and floor plan submittals.
5. Install all control wiring external to panels in electric metallic tubing or raceway. However, communication wiring, signal wiring and low voltage control wiring may be run without conduit in concealed, accessible locations if noise immunity is ensured. Contractor will be fully responsible for noise immunity and rewire in conduit if electrical or RF noise affects performance. Accessible locations are defined as areas inside mechanical equipment enclosures, such as heating and cooling units, instrument panels etc.; in accessible pipe chases with easy access, or suspended ceilings with easy access. Installation of wiring shall generally follow building lines. Run in a neat and

orderly fashion, bundled where applicable, and completely suspended (strapped to rigid elements or routed through wiring rings) away from areas of normal access. Tie and support conductors neatly with suitable nylon ties. Conductors shall not be supported by the ceiling system or ceiling support system. Conductors shall be pulled tight and be installed as high as practically possible in ceiling cavities. Wiring shall not be laid on the ceiling or duct. Conductors shall not be installed between the top cord of a joist or beam and the bottom of roof decking.

Contractor shall be fully responsible for noise immunity and rewire in conduit if electrical or RF noise affects performance.

6. Number-code or color-code conductors appropriately for future identification and servicing of control system. Code shall be as indicated on approved installation drawings.

C. Control Valves: Install so that actuators, wiring, and tubing connections are accessible for maintenance. Where possible, install with valve stem axis vertical, with operator side up. Where vertical stem position is not possible, or would result in poor access, valves may be installed with stem horizontal. Do not install valves with stem below horizontal, or down.

D. Freezestats: Install freezestats in a serpentine fashion where shown on drawing. Provide one foot of element for each square foot of coil face area. Where coil face area exceeds required length of element, provide multiple devices, wired in parallel for normally open close on trip application, wired in series for normally closed, open on trip application. Adequately support with coil clips.

E. Averaging Temperature Sensors: Cover no more than two square feet per linear foot of sensor length except where indicated. Generally where flow is sufficiently homogeneous/adequately mixed at sensing location, consult AE for requirements.

AE must specifically show locations of all flow meters and design in the straight length of duct or pipe required for accurate sensors. This length must be specifically shown on the drawing.

F. Fluid Flow Sensors: Install per manufacturer's recommendations in an unobstructed straight length of pipe.

G. Relative Humidity Sensors: Provide element guard as recommended by manufacturer for high velocity installations. For high limit sensors, position remote enough to allow full moisture absorption into the air stream before reaching the sensor.

H. Differential Pressure Transmitters: Provide valve bypass arrangement to protect against over pressure damaging the transmitter.

I. Flow Switches: Where possible, install in a straight run of pipe at least 15 diameters in length to minimize false indications.

J. Current Switches for Motor Status Monitoring: Adjust so that setpoint is below

minimum operating current and above motor no load current.

K. Supply Duct Pressure Transmitters:
   1. General: Install pressure tips with at least 4 'round equivalent' duct diameters of straight duct with no takeoffs upstream. Install pressure tips securely fastened with tip facing upstream in accordance with manufacturer's installation instructions. Locate the transmitter at an accessible location to facilitate calibration.
   2. VAV System 'Down-Duct' Transmitters: Locate pressure tips approximately 2/3 of the hydraulic distance to the most remote terminal in the air system.

L. Cutting and Patching Insulation: Repair insulation to maintain integrity of insulation and vapor barrier jacket. Use hydraulic insulating cement to fill voids and finish with material matching or compatible with adjacent jacket material.

END OF SECTION 23 09 51

SECTION 23 09 53 - BAS FIELD PANELS

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. Building Controller (BC)

B. Advance Application Specific Controller (AAC)

C. Application Specific Controller (ASC)

1.02 RELATED DOCUMENTS:

A. Section 23 09 50 - Building Automation System (BAS) General - Refer to this section for definitions of terminology

B. Section 23 09 51 - BAS Basic Materials, Interface Devices, and Sensors

C. Section 23 09 54 - BAS Communications Devices

D. Section 23 09 55 - BAS Software

E. Section 23 09 58 - Sequence of Operation

F. Section 23 09 59 - BAS Commissioning

1.03 DESCRIPTION OF WORK:

A. Furnish and install DDC Control units and/or Smart Devices required to support specified building automation system functions.

B. Refer to Section 23 09 50 for general requirements.

PART 2 - PRODUCTS

2.01 Stand-Alone Functionality

A. General: These requirements clarify the requirement for stand-alone functionality relative to packaging I/O devices with a controller. Stand-alone functionality is specified with the controller and for each Application Category specified in Part 3. This item refers to acceptable paradigms for associating the points with the processor.

B. Functional Boundary: Provide controllers so that all points associated with and common to one unit or other complete system/equipment shall reside within a single control unit. The boundaries of a standalone system shall be as dictated in the contract documents. Generally systems specified for the Application Category will dictate the boundary of the standalone control functionality. See related restrictions below. When referring to the controller as pertains to the standalone functionality, reference is specifically made to the processor.

One processor shall execute all the related I/O control logic via one operating system that uses a common programming and configuration tool.

C. The following configurations are considered acceptable with reference to a controller's standalone functionality:
   1. Points packaged as integral to the controller such that the point configuration is listed as an essential piece of information for ordering the controller (having a unique ordering number).
   2. Controllers with processors and modular back planes that allow plug in point modules as an integral part of the controller.
   3. I/O point expander boards, plugged directly into the main controller board to expand the point capacity of the controller.

   4. I/O point expansion devices connected to the main controller board via wiring and as such may be remote from the controller and that communicate via a sub LAN protocol. These arrangements to be considered standalone shall have a sub LAN that is dedicated to that controller and include no other controller devices (AACs or ASCs). All wiring to interconnect the I/O expander board shall be:
      a. Contained in the control panel enclosure;
      b. Or run in conduit. Wiring shall only be accessible at the terminations.

D. The following configurations are considered unacceptable with reference to a controller's standalone functionality:
   1. Multiple controllers enclosed in the same control panel to accomplish the point requirement.

2.02 Building Controller (BC)

A. General Requirements:
   1. The BC(s) shall provide fully distributed control independent of the operational status of the OWSs and CSS. All necessary calculations required to achieve control shall be executed within the BC independent of any other device. All control strategies performed by the BC(s) shall be both operator definable and modifiable through the Operator Interfaces.
   2. BCs shall perform overall system coordination, accept control programs, perform automated HVAC functions, control peripheral devices and perform all necessary mathematical and logical functions. BCs shall share information with the entire network of BCs and AACs/ASCs for full global control. Each controller shall be accessed through the CSS in normal operations. In the event that the CSS is not available, the controller shall permit multi-user operation from multiple OWS and mobile computers connected either locally or over the network. Each unit shall have its own internal RAM, non-volatile memory, microprocessor, battery backup, regulated power supply, power conditioning
      equipment, ports for connection of operating interface devices, and control enclosure.

BCs shall be programmable from the CSS, OWS, mobile computer, or hand held device. BC shall contain sufficient memory for all specified global control strategies, user defined reports and trending, communication programs, and central alarming.

3. BCs shall be connected to a controller network that qualifies as a controlling LAN.
4. All BCs shall be provided with a UPS to protect against memory loss and allow for continuous communication with the CSS in the event of a loss of power.
   a. The UPS shall be a 500 VA UPS equal to APC Back-UPS CS, 300 Watts / 500 VA, Input 120V / Output 120V, Interface Port DB-9 RS-232, USB
5. In addition BCs may provide intelligent, standalone control of BAS functions. Each BC may be capable of standalone direct digital operation utilizing its own processor, non-volatile memory, input/output, wiring terminal strips, A/D converters, real-time clock/calendar and voltage transient and lightning protection devices. Refer to standalone functionality specified above.
6. The BC may provide for point mix flexibility and expandability. This requirement may be met via either a family of expander boards, modular input/output configuration, or a combination thereof. Refer to stand alone functionality specified above.
7. All BC point data, algorithms and application software shall be modifiable from the CSS and OWS.
8. Each BC shall execute application programs, calculations, and commands via a microprocessor resident in the BC. The database and all application programs for each BC shall be stored in non-volatile or battery backed volatile memory within the BC and will be able to upload/download to/from the CSS.
9. BC shall provide buffer for holding alarms, messages, trends etc.
10. Each BC shall include self-test diagnostics, which allow the BC to automatically alarm any malfunctions, or alarm conditions that exceed desired parameters as determined by programming input.
11. Each BC shall contain software to perform full DDC/PID control loops.
12. For systems requiring end-of-line resistors those resistors shall be located in the BC.
13. Input-Output Processing

    a. Digital Outputs (DO): Outputs shall be rated for a minimum 24 Vac or Vdc, 1 amp maximum current. Each shall be configurable as normally open or normally closed. Each output shall have an LED to indicate the operating mode of the output and a manual hand off or auto switch to allow for override. Each DO shall be discrete outputs from the BC's board (multiplexing to a separate manufacturer's board is unacceptable). Provide suppression to limit transients to acceptable levels.
    b. Analog Inputs (AI): AI shall be 0-5 Vdc, 0-10 Vdc, 0-20 Vdc, and 0-20 mA. Provide signal conditioning, and zero and span calibration for each input. Each input shall be a discrete input to the BC's board (multiplexing to a separate

manufacturers board is unacceptable unless specifically indicated otherwise). A/D converters shall have a minimum resolution of 12 bits.

c. Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the BC and shall be isolated from the main board. Software multiplexing of an AI and resistors may only be done in non-critical applications and only with prior approval of Architect/Engineer.

d. Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.

e. Electronic Analog Outputs (AO): Voltage mode: 0-5 Vdc and 0-10 Vdc; Current mode: 4-20 mA. Provide zero and span calibration and circuit protection. Pulse Width Modulated (PWM) analog via a DO [and transducer] is acceptable only with State approval (Generally these will not be allowed on loops with a short time constant such as discharge temperature loops, economizer loops, pressure control loops and the like. They are generally acceptable for standard room temperature control loops.). Where these are allowed, transducer/actuator shall be programmable for normally open, normally closed, or hold last position and shall allow adjustable timing. Each DO shall be discrete outputs from the BC's board (multiplexing to a separate manufacturers board is unacceptable). D/A converters shall have a minimum resolution of 10 bits.

f. Pulsed Inputs: Capable of counting up to 8 pulses per second with buffer to accumulate pulse count. Pulses shall be counted at all times.

14. A communication port for operator interface through a mobile computer shall be provided in each BC. It shall be possible to perform all program and database back-up, system monitoring, control functions, and BC diagnostics through this port. Standalone BC panels shall allow temporary use of portable devices without interrupting its normal operation.

15. Each BC shall be equipped with loop tuning algorithm for precise proportional, integral, derivative (PID) control. Loop tuning tools provided with the CSS software is acceptable. In any case, tools to support loop tuning must be provided such that P, I, and D gains are automatically calculated.

16. All analog output points shall have a selectable failure setpoint. The BC shall be capable of maintaining this failure setpoint in the event of a system malfunction, which causes loss of BC control, or loss of output signal, as long as power is available at the BC. The failure setpoint shall be selectable on a per point basis.

17. Slope intercepts and gain adjustments shall be available on a per-point basis.

18. BC Power Loss:

a. Upon a loss of power to any BC, the other units on the controlling LAN shall not in any way be affected.

b. Upon a loss of power to any BC, the battery backup shall ensure that the energy management control software, the Direct Digital Control software, the database parameters, and all other programs and data stored in the RAM are retained for a minimum of fifty (50) hours. An alarm diagnostic message shall indicate that the BC is under battery power.

c. Upon restoration of power within the specified battery backup period, the BC shall resume full operation without operator intervention. The BC shall automatically reset its clock such that proper operation of any time dependent function is possible without manual reset of the clock. All monitored functions shall be updated.

d. Should the duration of a loss of power exceed the specified battery back-up period or BC panel memory be lost for any reason, the panel shall automatically report the condition (upon resumption of power) and be capable of receiving a download via the network from the CSS or a mobile computer. In addition, the State shall be able to upload the most current versions of all energy management control programs, Direct Digital Control programs, database parameters, and all other data and programs in the memory of each BC to the CSS or a mobile computer via the network or the local USB or RS-232C port.

19. BC Failure:
    a. Building Controller LAN Data Transmission Failure: BC shall continue to operate in stand-alone mode. BC shall store loss of communication alarm along with the time of the event. All control functions shall continue with the global values programmable to either the last value or a specified value. Peer BCs shall recognize the loss and report alarm.
    b. BC Hardware Failure: BC shall cease operation and terminate communication with other devices. All outputs shall go to their specified fail position.
20. Each BC shall be equipped with firmware resident self-diagnostics for sensors and be capable of assessing an open or shorted sensor circuit and taking an appropriate control action (close valve, damper, etc.).
21. BCs may include network communications interface functions for controlling secondary controlling LANs Refer to Section 23 09 54 - BAS System Communications Devices for requirements if this function is packaged with the BC.
22. A minimum of four levels of privileges shall be provided at each BC.
23. All local user accounts shall be password protected. Strong password shall be used and complies with the State security standard.
24. BCs shall be mounted on equipment, in packaged equipment enclosures, or locking wall mounted in a NEMA 1 enclosure, as specified elsewhere.

B. BACnet Building Controller Requirements:
    1. The BC(s) shall support all BIBBs defined in the BACnet-IP (B-BC) device profile as defined in the BACnet standard.
    2. BCs shall communicate over the BACnet-IP LAN.
    3. Each BC shall be connected to the BACnet-IP LAN communicating to/from other BCs.

2.03 Advanced Application Specific Controller (AAC) and Application Specific Controller (AsC)

A. General Requirements:
    1. AACs and ASCs shall provide intelligent, standalone control of HVAC equipment.

Each unit shall have its own internal RAM, non-volatile memory and will continue to operate all local control functions in the event of a loss of communications on the ASC LAN or
sub-LAN. Refer to standalone requirements by application specified in Part 3 of this section. In addition, it shall be able to share information with every other BC and AAC
/ASC on the entire network.

2. Each AAC and ASC shall include self-test diagnostics that allow the AAC /ASC to automatically relay to the BC, or LAN Interface Device, any malfunctions or abnormal conditions within the AAC /ASC or alarm conditions of inputs that exceed desired parameters as determined by programming input.
3. AACs and ASCs shall include sufficient memory to perform the specific control functions required for its application and to communicate with other devices.
4. Each AAC and ASC must be capable of stand-alone direct digital operation utilizing its own
processor, non-volatile memory, input/output, minimum 8 bit A to D conversion, voltage transient and lightning protection devices. All volatile memory shall have a battery backup of at least fifty- (50) hrs with a battery life of (5) five years.
5. All point data; algorithms and application software within an AAC /ASC shall be modifiable from the OWS.
6. AAC and ASC Input-Output Processing
   a. Digital Outputs (DO): Outputs shall be rated for a minimum 24 VAC or VDC, 1 amp maximum current. Each shall be configurable as normally open or normally closed. Each output shall have an LED to indicate the operating mode of the output and a manual hand off or auto switch to allow for override (Only AAC requires HOA). Each DO shall be discrete outputs from the AAC/ASC's board (multiplexing to a separate manufacturer's board is unacceptable). Provide suppression to limit transients to acceptable levels.
   b. Analog Inputs (AI): AI shall be O-5 Vdc, 0-10Vdc, 0-20Vdc, and 0-20 mA. Provide signal conditioning, and zero and span calibration for each input. Each input shall be a discrete input to the BC's board (multiplexing to a separate manufacturers board is unacceptable unless specifically indicated otherwise). A/D converters shall have a minimum resolution of 8-10 bits depending on application.
   c. Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the BC and shall be isolated from the main board. Software multiplexing of an AI and resistors may only be done in non-critical applications and only with prior approval of Architect/Engineer
   d. Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.
   e. Electronic Analog Outputs (AO) as required by application: voltage mode, 0-5VDC and 0-10VDC; current mode (4-20 mA). Provide zero and span calibration and circuit protection. Pulse Width Modulated (PWM) analog via a DO [and transducer] is acceptable only with State approval (Generally, PWM will not be allowed on loops

with a short time constant such as discharge temperature loops, economizer loops, pressure control loops and the like. They are generally acceptable for standard room temperature control loops.). Where PWM is allowed, transducer/actuator shall be programmable for normally open, normally closed, or hold last position and shall allow adjustable timing. Each DO shall be discrete outputs from the BC's board (multiplexing to a separate manufacturers board is unacceptable). D/A converters shall have a minimum resolution of 8 bits.

B. BACnet AAC(s) and ASC(s) Requirements:
   1. The AAC(s) and ASC(s) shall support all BIBBs defined in the BACnet Building Controller
      (B-AAC and B-ASC) device profile as defined in the BACnet standard.
   2. AAC(s) and ASC(s) shall communicate over the BACnet Building Controller LAN or the ASC LAN or sub-LAN.
   3. Each BC shall be connected to the BACnet Building Controller LAN communicating to/from other BCs.

C. Terminal Box Controllers:
   1. Terminal box controllers controlling damper positions to maintain a quantity of supply or exhaust air serving a space shall have an automatically initiated function that resets the volume regulator damper to the fully closed position on a scheduled basis. The controllers shall initially be set up to perform this function once every 24 hours. The purpose of this required function is to reset and synchronize the actual damper position with the calculated damper position and to assure the damper will completely close when commanded. The software shall select scheduled boxes randomly and shall not allow more than 5% of the total quantity of controllers in a building to perform this function at the same time. This reset shall be performed while the AHU is operating. The BAS shall send an alarm for any terminal box that has been reset and does not indicate 0 cfm flow with the damper commanded closed.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF CONTROL SYSTEMS:

A. General: Install systems and materials in accordance with manufacturer's instructions, specifications roughing-in drawings and details shown on drawings. Contractor shall install all controllers in accordance with manufacturer's installation procedures and practices.

3.03 HARDWARE APPLICATION REQUIREMENTS

A. General: The functional intent of this specification is to allow cost effective application of manufacturers standard products while maintain the integrity and reliability of the control functions. A BC as specified above is generally fully featured and customizable whereas the AAC/ASC refers to a more cost-effective unit designed for lower-end applications. Specific requirements indicated below are required for the respective application. Manufacturer may apply the most cost-effective unit that meets the requirement of that application.

B. Standalone Capability: Each Control Unit shall be capable of performing the required sequence of operation for the associated equipment. All physical point data and calculated values required to accomplish the sequence of operation shall originate within the associated CU with only the exceptions enumerated below. Refer to Item 2.01 above for physical limitations of standalone functionality. Listed below are functional point data and calculated values that shall be allowed to be obtained from or stored by other CUs or SDs via LAN.

C. Where associated control functions involve functions from different categories identified below, the requirements for the most restrictive category shall be met.

D. Application Category 0 (Distributed monitoring)
   1. Applications in this category include the following:
      a. Monitoring of variables that are not used in a control loop, sequence logic, or safety.
   2. Points on BCs, AACs, and ASCs may be used in these applications as well as SDs and/or general-purpose I/O modules.
   3. Where these points are trended, contractor shall verify and document that the network bandwidth is acceptable for such trends and is still capable of acceptable and timely control function.

E. Application Category 1 (Application Specific Controller):
   1. Applications in this category include the following:
      a. Fan Coil Units
      b. Airflow Control Boxes (VAV and Constant Volume Terminal Units)
      c. Misc. Heaters
      d. Unitary equipment <15 tons (Package Terminal AC Units, Package Terminal Heat Pumps, Split-System AC Units, Split-System Heat Pumps, Water-Source Heat Pumps)
      e. Induction Units
      f. Variable Speed Drive (VSD) controllers not requiring safety shutdowns of the controlled device.
   2. ASCs may be used in these applications.
   3. Standalone Capability: Provide capability to execute control functions for the application for a given setpoint or mode, which shall generally be occupied mode control. Only the following data (as applicable) may be acquired from other controllers

via LANs. In the event of a loss of communications with any other controller, or any fault in any system hardware that interrupts the acquisition of any of these values, the ASC shall use the last value obtained before the fault occurred. If such fault has not been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.

Physical/Virtual Point	Default Value
Scheduling Period	Normal
Morning Warm-Up	Off (cold discharge
air) Load Shed	Off (no shedding)
Summer/Winter	Winter
[Trend Data	N/A]
[Smoke Pressurization Mode	Normal Mode]

4. Mounting:
   a. ASCs that control equipment located above accessible ceilings shall be mounted on the equipment in an accessible enclosure that does not hinder maintenance of mechanical equipment and shall be rated for plenum use.
   b. ASCs that control equipment mounted in a mechanical room may either be mounted in, on the equipment, or on the wall of the mechanical room at an adjacent, accessible location.
   c. ASCs that control equipment located in occupied spaces or outside shall either be mounted within the equipment enclosure (responsibility for physical fit remains with the contractor) or in a nearby mechanical/utility room in which case it shall be enclosed in
   a NEMA 1, locking enclosure.
   d. Section 23 09 53 contractor may furnish ASCs to the terminal unit manufacturer for factory mounting.
5. Programmability: Operator shall be able to modify all setpoints (temperature and airflow), scheduling parameters associated with the unit, tuning and set up parameters, interstage timing parameters, and mode settings. Application-specific block control algorithms may
   be used to meet the sequence of operations. The ability to customize the control algorithm is not required unless specifically indicated otherwise.
6. LAN Restrictions: Limit the number of nodes on the network to the maximum recommended by the manufacturer.

F. Application Category 2 (General Purpose Terminal Controller)
   1. Applications in this category include the following:
      a. Unitary Equipment >= 15 tons (Air Conditioners, Heat Pumps, Packaged Heating/Cooling Units, and the like)<
      b. Small, Constant Volume Single Zone Air Handling
      Units c. Constant Volume Pump Start/Stop
      d. Misc. Equipment (Exhaust Fan) Start/Stop
      e. Misc. Monitoring (not directly associated with a control sequence and where

trending is not critical)

f. Steam Converter Control

2. BCs may be used in these applications.
3. ASC's may be used in these applications provided the ASC meets all requirements specified below. This category requires a general-purpose ASC to which application-specific control algorithms can be attached.
4. Standalone Capability: Only the following data (as applicable) may be acquired from other ASCs via LANs. In the event of a loss of communications with any other ASCs, or any fault in any system hardware that interrupts the acquisition of any of these values, the AAC/ASC shall use the last value obtained before the fault occurred. If such fault has not
been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.

Physical/Virtual Point	Default Delay Time	Default Value
Outside Air Temperature Outside	3 minutes	80°F
Air Humidity Outside	3 minutes	60%RH
Air Enthalpy Trend	3 minutes	30 Btu/lb
Cooling/Heating Requests	3 minutes	N/A
Smoke Pressurization	3 minutes	None
Mode Smoke Exhaust	3 minutes	Normal Mode
Command		Normal Mode

5. Mounting:
   a. ASCs that control equipment located above accessible ceilings shall be mounted on the equipment so as not to hinder mechanical maintenance and shall be rated for plenum use.
   b. ASCs that control equipment located in occupied spaces or outside shall either be mounted within the equipment enclosure (responsibility for physical fit remains with the contractor) or in a nearby mechanical/utility room in which case it shall be enclosed in
   a NEMA 1, locking enclosure.
6. Programmability: Operator shall be able to modify all setpoints (temperature and airflow), scheduling parameters associated with the unit, tuning and set up parameters, interstage timing parameters, and mode settings. Operator shall be able to address and configure spare inputs for monitoring. [Operator shall be able to address and configure spare outputs for simple single loop control actions or event initiated actions.] Application-specific block control algorithms shall used to meet the sequence of operations. The ability to customize the control algorithm is not required unless specifically indicated otherwise.

7. LAN Restrictions: Limit the number of nodes servicing any one of these applications on the AAC/ASC LAN to 32.

G. Application Category 3 (Advanced Application Controller)
1. Applications in this category include the following:
   a. Large Constant Volume Air Handlers
   b. VAV Air Handlers generally >5,000 and <10,000cfm
   c. Dual Duct Air Handlers generally >5000 and < 10,000 cfm d. Multizone Air Handlers
   e. Self-Contained VAV Units
2. BCs may be used in these applications.
3. AAC's may be used in these applications provided:
   a. The AAC's meets all requirements specified below.
   b. All control functions and physical I/O associated with a given unit resides in one AAC.
   c. Input A/D is 10-bit. Exception: 8-bit input A/D can be used when matched with high accuracy sensors, the range of which meets the resolution requirements specified for the applicable sensor in Section 23 09 51.
   d. Pulsed inputs required for the application can be monitored and accumulated effectively.
4. Standalone Capability: Only the following data (as applicable) may be acquired from other AACs via LANs. In the event of a loss of communications with any other AACs, or any fault in any system hardware that interrupts the acquisition of any of these values, the AAC shall use the last value obtained before the fault occurred. If such fault has not been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.

physical/virtual point	default delay time	default value
Outside Air Temperature	3 minutes	80°F
Outside Air Humidity	3 minutes	60%RH
Outside Air Enthalpy	3 minutes	30 Btu/lb
Enable Local Operation		Last Value
Cooling/Heating Requests	3 minutes	None
Smoke Pressurization Mode	3 minutes	Normal Mode
Smoke Exhaust Command	3 minutes	Normal Mode

5. Mounting:
   a. AACs that control equipment located above accessible ceilings shall be mounted on the equipment so as not to hinder mechanical maintenance and shall be rated for plenum use.
   b. AACs that control equipment located in occupied spaces or outside shall either be mounted within the equipment enclosure (responsibility for physical fit remains with the contractor) or in a nearby mechanical/utility room in which case it shall be

enclosed in a NEMA 1, locking enclosure.

6. Programmability: Operator shall be able to modify all setpoints (temperature and airflow), scheduling parameters associated with the unit, tuning and set up parameters, interstage timing parameters, and mode settings. Operator shall be able to address and configure spare inputs for monitoring. Operator shall be able to program custom DDC control algorithms and specify trending parameters, which will be retained in memory in the event of a loss of communications. Application-specific block control algorithms may be used
provided they meet the sequence of operations. The control algorithms shall be completely customizable.
7. LAN Restrictions: Each LAN which participates in the transfer of data between the CU and the local operator workstation shall be subject to the following criteria:
   a. Limit the number of nodes servicing any one of these applications on the AAC/ASC LAN to 16.
   b. The Building Controller LAN shall be subject only to manufacturer's published LAN limitations.

H. Application Category 4
1. Applications in this category include the following:

   a. Central Cooling
   b. Plant Central
   c. Heating Plant
   d. Cooling Towers
      Sequenced or Variable Speed Pump Control

   e. Local Chiller Control (unit specific)
   f. Local Free Cooling Heat Exchanger Control
   g. Air Handlers over 10,000 cfm or serving critical
2. BCareas s shall be used in these applications.

3.04 CONTROL UNIT REQUIREMENTS

A. Refer to Section 23 09 50 for requirements pertaining to control unit quantity and location.

END OF SECTION 23 09 53

SECTION 23 09 54 - BAS COMMUNICATION DEVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Network Integration Devices

1.02 RELATED DOCUMENTS:

A. Section 23 09 50 - Building Automation System (BAS) General

B. Section 23 09 51 - BAS Basic Materials, Interface Devices, and Sensors

C. Section 23 09 53 - BAS Field Panels

D. Section 23 09 55 - BAS Software

E. Section 23 09 58 - Sequences of Operation

F. Section 23 09 59 - BAS Commissioning

1.03 DESCRIPTION OF WORK

A. Contractor shall provide all interface devices and software to provide an integrated system connecting BCs, AACs, ASCs and Gateways to the State network.

PART 2 - PRODUCTS

2.01 Network Connection

A. State WAN: Refer Section 23 09 50 Part 1.11.C.1 - Building Automation System (BAS) General for description of System Architecture.

B. The following BIBBs must be supported on the Local Supervisory LAN using Ethernet either directly or through a gateway:
   1. BACnet Data Sharing Objects (DS-):
      a. Read Property (RP-A) Initiate
      b. Read Property (RP-B) Execute
      c. Read Property Multiple (RPM-A) Initiate
      d. Read Property Multiple (RPM-B) Execute
      e. Write Property (WP-A) Initiate
      f. Write Property (WP-B) Execute
      g. Write Property Multiple (WPM-A) Initiate
      h. Write Property Multiple (WPM-B) Execute
      i. COV Unsubscribed (COVU-A) Initiate
      j. COV Unsubscribed (COVU-B) Execute
   2. BACnet Alarm and Event Object (AE-)
      a. Confirmed Event Notification (N-B) Initiate

b. Unconfirmed Event Notification (N-B) Initiate

C. Refer to Section 23 09 55 Part III for the BACnet Object naming convention.

2.02 BACnet Gateways

A. Gateways shall be provided to link non-BACnet control products to the BACnet inter-network. All of the functionality described in this section is to be provided by using the BACnet capabilities. Each Gateway shall have the ability to expand the number of BACnet objects of each type supported by 20% to accommodate future system changes.

B. Each Gateway shall provide values for all points on the non-BACnet side of the Gateway to BACnet devices as if the values were originating from BACnet objects. The Gateway shall also provide a way for BACnet devices to modify (write) all points specified by the AOC using standard BACnet services. All points are required to be writable for each site.

C. The Gateway shall implement BACnet schedule objects and permit both read and write access to the schedules from the BC.

D. Each Gateway shall provide a way to collect and archive or trend (time, value) data pairs.

E. Each Gateway and any devices that the Gateway represents which have time-of-day information shall respond to workstation requests to synchronize the date and time. Each Gateway and any devices that the Gateway represents shall support dynamic device binding and dynamic object binding.

F. All points in the system shall be made network visible through the use of standard BACnet objects or through proprietary BACnet extensions that the workstation also supports. All points shall be writable using standard BACnet services.

G. All devices have a Device Object instance number that is unique throughout the entire inter-network. All BACnet devices shall be configured with a Device Object instance number that is based on the format specified (shown in decimal notation). This includes all physical devices as well as any logical BACnet devices that are physically represented by Gateways.

H. All BACnet Interoperability Building Blocks (BIBBs) are required to be supported for each native BACnet device or Gateway. The Gateway shall support all BIBBs defined in the BACnet Gateway's device profile as defined in the BACnet standard.

2.03 Controller LOCAL AREA NETWORK Interface Devices (LANID)

A. The LANID shall be a microprocessor-based communications device which acts as a gateway/router between the Primary Controlling LAN and the Secondary Controlling LAN. It provides an operator interface. These may be provided within a BC or as a separate device.

B. The LANID shall perform information translation between the Primary Controlling LAN and the Secondary Controlling LAN, supervise communications on a polling Secondary Controlling LAN, and be applicable to systems in which the same functionality is not provided in the BC. In systems where the LANID is a separate device, it shall contain its own microprocessor, RAM, battery, real-time clock, communication ports, and power supply as specified for a BC in Section
23 09 53. Each LANID shall be mounted in a lockable enclosure.

C. Each LANID shall support interrogation, full control, and all utilities associated with all BCs on the Primary Controlling LAN, all AACs and ASCs connected to all Secondary Controlling LANs under the Primary Controlling LAN, and all points connected to those PCUs and SCUs.

D. Upon loss of power to a LANID, the battery shall provide for minimum 100-hour backup of all programs and data in RAM. The battery shall be sealed and self-charging.

E. The LANID shall be transparent to control functions and shall not be required to control information routing on the Primary Controlling LANControlling LANControlling LANControlling LANControlling LAN

F. All BACnet Interoperability Building Blocks (BIBBs) are required to be supported for each native BACnet device or Gateway. The Gateway shall support all BIBBs defined in the BACnet Gateway's device profile as defined in the BACnet standard.

2.04 Local Supervisory LAN Gateways/Routers

A. The gateway/router shall be a microprocessor-based communications device that acts as a gateway/router between the Supervisory LAN CSSs or OWS and the Controlling LAN.

B. The gateway/router shall perform information translation between the Controlling LAN and the Local Supervisory LAN, and shall use BACnet over IP. When BACnet is used, refer to the requirements of the BACnet Gateways specified herein.

C. The gateway/router shall contain its own microprocessor, RAM, battery, real-time clock, communication ports, and power supply as specified for a BC in Section 23 09 53. Each gateway/router shall be mounted in a lockable enclosure.

D. The gateway/router shall allow centralized overall system supervision, operator interface, management report generation, alarm annunciation, acquisition of trend data, and communication with control units. It shall allow system operators to perform the following functions from the CSS, and OWSs:
   1. Configure systems.
   2. Monitor and supervise control of all points.
   3. Change control setpoints.
   4. Override input values.

5. Override output values
6. Enter programmed start/stop time schedules.
7. View and acknowledge alarms and messages.
8. Receive, store and display trend logs and management reports.
9. Upload/Download programs, databases, etc. as specified.

E. Upon loss of power to the gateway/router, the battery shall provide for minimum 100 hour backup of all programs and data in RAM. The battery shall be sealed and self-charging.

F. The gateway/router shall be transparent to control functions and shall not be required to control information routing on the Controlling LAN

PART 3 - EXECUTION

3.01 INSPECTION:

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF CONTROL SYSTEMS:

A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings.

B. Contractor shall provide all interface devices and software to provide an integrated system.

C. Contractor shall closely coordinate with the State, or designated representative, to establish IP addresses and communications to assure proper operation of the building control system on the State (DE) network.

END OF SECTION 23 09 54

SECTION 23 09 55 - BAS SOFTWARE AND PROGRAMMING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. System Software

B. Programming Description

C. Control Algorithms

D. Energy Management Applications

E. Password Protection

F. Alarm Reporting

G. Trending

H. Data Acquisition and Storage

I. Point Structuring

J. Dynamic Color Graphics

1.02 RELATED DOCUMENTS:

A. Section 23 09 50 - Building Automation System (BAS) General

B. Section 23 09 51 - BAS Basic Materials, Interface Devices, and Sensors

C. Section 23 09 53 - BAS Field Panels

D. Section 23 09 54 - BAS Communications Devices

E. Section 23 09 58 - Sequences of Operation

F. Section 23 09 59 - BAS Commissioning

1.03 DESCRIPTION OF WORK:

A. Fully configure systems and furnish and install all software, programming and dynamic color graphics for a complete and fully functioning system as specified.

B. Refer to Section 23 09 50 - Building Automation System (BAS) for general requirements

C. Refer to 23 09 58 - Sequence of Operation for specific sequences of operation for controlled equipment.

1.04 LICENSING

A. Include licensing for all software packages at all required workstations.

B. All operator interface, programming environment, networking, database management and any other software used by the Contractor to install the system or needed to operate the system to its full capabilities shall be licensed and provided to the State.

C. All BAS software should be available on CSS(s) provided, and on all Portable Operator Terminals. All software keys to provide all rights shall be installed on CSS. At least 2 sets of media (CD or DVD) shall be provided with backup software and configurations for all software provided, so that the State may reinstall any software as necessary

D. Provide licensing and original software media for each device. Include all BAS software licenses and all required third party software licenses.

E. Upgrade all software packages to the release (version) in effect at the end of the Warranty Period.

F. Refer to Section 23 09 50 - Building Automation System (BAS) General for further requirements.

PART 2 - PRODUCTS

2.01 SYSTEM SOFTWARE-GENERAL

A. Functionality and Completeness: The Contractor shall furnish and install all software and programming necessary to provide a complete and functioning system as specified. The Contractor shall include all software and programming not specifically itemized in these Specifications, which is necessary to implement, maintain, operate, and diagnose the system in compliance with these Specifications.

B. Configuration: The software shall support the system as a distributed processing network configuration.

2.02 CONTROLLER SOFTWARE

A. BC Software Residency: Each BC as defined below shall be capable of controlling and monitoring of all points physically connected to it. All software including the following shall reside and execute at the BC:
   1. Real-Time Operating System software
   2. Real-Time Clock/Calendar and network time synchronization
   3. BC diagnostic software
   4. LAN Communication software/firmware
   5. Direct Digital Control software
   6. Alarm Processing and Buffering software
   7. Energy Management software
   8. Data Trending, Reporting, and Buffering software
   9. I/O (physical and virtual) database
   10. Remote Communications software

B. AAC/ASC Software Residency: Each AAC/ASC as defined below shall be capable of controlling and monitoring of all points physically connected to it. As a minimum, software

including the following shall reside and execute at the AAC/ASC. Other software to support other required functions of the AAC/ASC may reside at the BC or LAN interface device (specified in Section 23 09 54) with the restrictions/exceptions per application provided in Section 23 09 53:

1. Real-Time Operating System software
2. AAC/ASC diagnostic software
3. LAN Communications software
4. Control software applicable to the unit it serves that will support a single mode of operation
5. I/O (physical and virtual) database to support one mode of operation

C. Standalone Capability: BC shall continue to perform all functions independent of a failure in other BC/AAC/ASC, CSS, or other communication links to other BCs/AACs/ASCs or CSSs. Trends and runtime totalization shall be retained in memory. Runtime totalization shall be available on all digital input points that monitor electric motor status. Refer also to Section 23 09 53 for other aspects of standalone functionality.

D. Operating System: Controllers shall include a real-time operating system resident in ROM. This software shall execute independently from any other devices in the system. It shall support all specified functions. It shall provide a command prioritization scheme to allow functional override of control functions. Refer also to Section 23 09 53 for other aspects of the controller's operating system.

E. Network Communications: Each controller shall include software/firmware that supports the networking of CUs on a common communications trunk that forms the respective LAN. Network support shall include the following:

1. Controller communication software shall include error detection, correction, and re-transmission to ensure data integrity.
2. Operator/System communication software shall facilitate communications between other BCs, all subordinate AACs/ASCs, Gateways and LAN Interface Devices or CSS. Software shall allow point interrogation, adjustment, addition/deletion, and programming while the controller is online and functioning without disruption to unaffected points. The software architecture shall allow networked controllers to share selected physical and virtual point information throughout the entire system.

F. Diagnostic Software: Controller software shall include diagnostic software that checks memory and communications and reports any malfunctions.

G. Alarm/Messaging Software: Controller software shall support alarm/message processing and buffering software as more fully specified below.

H. Application Programs: CUs shall support and execute application programs as more fully specified below:

1. All Direct Digital Control software, Energy Management Control software, and functional block application programming software templates shall be provided in a 'ready-to-use' state, and shall not require (but shall allow) user programming.

I. Security: Controller software shall support multiple level privileges access restriction as more fully specified below.

J. Direct Digital Control: Controller shall support application of Direct Digital Control Logic. All logic modules shall be provided pre-programmed with written documentation to support their application. Provide the following logic modules as a minimum:
   1. Proportional-Integral-Derivative (PID) control with analog, PWM and floating output
   2. Two Position control (Hi or Low crossing with deadband)
   3. Single-Pole Double-Throw relay
   4. Delay Timer (delay-on-make, delay-on-break, and interval)
   5. Hi/Low Selection
   6. Reset or Scaling Module
   7. Logical Operators (AND, OR, NOT, XOR)

K. Psychrometric Parameters: Controller software shall provide preprogrammed functions to calculated and present psychrometric parameters (given temperature and relative humidity) including the following as a minimum: Enthalpy, Wet Bulb Temperature.

L. Updating/Storing Application Data: Site-specific programming residing in volatile memory shall be uploadable/downloadable from an OWS or CSS using BACnet services connected locally or through the network. Initiation of an upload or download shall include all of the following methods: Manual, Scheduled, and Automatic upon detection of a loss or change.

M. Restart: System software shall provide for orderly shutdown upon loss of power and automatic restart upon power restoration. Volatile memory shall be retained; outputs shall go to programmed fail-safe (open, closed, or last) position. Equipment restart shall include a user definable time delay on each piece of equipment to stagger the restart. Loss of power shall be

   alarmed at operator interface indicating date and time.

N. Time Synchronization: Automatic time synchronization shall be provided using BACnet services. Operators shall be able to set the time and date in any device on the network that supports time-of-day functionality. The operator shall be able to select to set the time and date for an individual device, devices on a single network, or all devices simultaneously.

O. Misc. Calculations: System software shall automate calculation of psychometric functions, calendar functions, kWh/kW, and flow determination and totalization from pulsed or analog inputs, curve-fitting, look-up table, input/output scaling, time averaging of inputs and A/D conversion coefficients.

2.03 APPLICATION PROGRAMMING DESCRIPTION

A. The application software shall be user programmable.

B. This specification generally requires a programming convention that is logical, easy to learn, use, and diagnose. General approaches to application programming shall be provided by one, or a combination, of the following conventions:
   1. Point Definition: Provide templates customized for point type, to support input of

individual point information. Use standard BACnet Objects as applicable.

2. Graphical Block Programming: Manipulation of graphic icon 'blocks', each of which represents a subroutine, in a functional/logical manner forming a control logic diagram. Blocks shall allow entry of adjustable settings and parameters via pop-up windows. Provide a utility that shall allow the graphic logic diagrams to be directly compiled into application programs. Logic diagrams shall be viewable either off-line, or on-line with real-time block output values.
3. Functional Application Programming: Pre-programmed application specific programs that allow/require limited customization via 'fill-in-the-blanks' edit fields. Typical values would be setpoints gains, associated point names, alarm limits, etc.

C. Provide a means for testing and/or debugging the control programs both off-line and on-line.

2.04 ENERGY MANAGEMENT APPLICATIONS

A. System shall have the ability to perform all of the following energy management routines via preprogrammed function blocks or template programs. As a minimum provide the following whether or not required in the software:
1. Time-of-Day Scheduling
2. Calendar-Based Scheduling
3. Holiday Scheduling
4. Temporary Schedule Overrides
5. Optimal Start / Optimal Stop based on space temperature offset, outdoor air temperature, and building heating and cooling capacitance factors as a minimum
6. Night Setback and Morning Recovery Control, with ventilation only during occupancy
7. Economizer Control (enthalpy or dry-bulb)
8. Peak Demand Limiting / Load Shedding
9. Dead Band Control

B. All programs shall be executed automatically without the need for operator intervention, and shall be flexible enough to allow operator customization. Programs shall be applied to building equipment as described in Section 23 09 58 - Sequence of Operation.

2.05 ACCESS PRIVILEGES

A. Multiple-level access privileges shall be provided. A minimum of four (4) levels of access shall be supported.

B. The highest level of access, Administrator Level access, shall allow the BAS administrator to perform application, database, and user management functions.

C. Each login credentials shall be assigned to a pre-defined level of access. Alternately, a comprehensive list of accessibility/functionality items shall be provided, to be enabled or disabled for each user according to the level of access granted.

D. Operators shall be able to perform only those commands available for the access level assigned to their login credentials.

E. Login credentials are stored in the BC's local database. A minimum of 20 user names shall

be supported and programmed per the State's direction.

F. Login credentials can be looked up using the Lightweight Directory Access (LDAP) through the BAS server.

G. Strong password shall be used on all login credentials.

H. User-definable, automatic log-off timers from 1 to 60 minutes shall be provided to prevent users from inadvertently leaving interface device unattended.

I. At system handover, all default and Contractor created login credentials for the system shall be provided to the State and all temporary login credentials shall be removed.

2.06 ALARM AND EVENT MANAGEMENT REPORTING

A. Alarm management shall be provided to monitor, buffer, and direct alarms and messages to operator devices and memory files. Each BC shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic, and prevent alarms from being lost. At no time shall a BCs ability to report alarms be affected by either operator activity at an OWS or local handheld device, or by communications with other panels on the network.

1. Alarm Descriptor: Each alarm or point change shall include that point's English language description and the time and date of occurrence. In addition to the alarm's descriptor and the time and date, the user shall be able to print, display and store an alarm message to more fully describe the alarm condition or direct operator response.
2. Alarm Prioritization: The software shall allow users to define the handling and routing of each alarm by their assignment to discrete priority levels. A minimum of five (5) priority levels shall be provided - Level 1 Life Safety (i.e. smoke detector), Level 2 Critical (i.e. controller failure), Level 3 Abnormal (i.e. out-of-range temperature), Level 4 Energy Waste (i.e. fighting valves), Level 5 Maintenance Message (i.e. runtime monitor, filter status). For each priority level, users shall have the ability to enable or disable an audible tone whenever an alarm is reported and whenever an alarm returns to normal condition. Users shall have the ability to manually inhibit alarm reporting for each individual alarm and for each priority level. Contractor shall coordinate with the State on establishing alarm priority definitions.
3. Alarm Report Routing: Each alarm priority level shall be associated with a unique user-defined list of operator devices including any combination of local or remote workstations, printers and workstation disk files. All alarms associated with a given priority level shall be routed to all operator devices on the user-defined list and/or email to designated State email address (mailbox resource) associated with that priority level. For each priority level, alarms shall be automatically routed to a default operator device in the event that alarms are unable to be routed to any operator device assigned to the priority level.
4. Auto-Dial Alarm Routing: For alarm priority levels that include a mobile device as one of the listed reporting destinations, the BC shall initiate a call to report the alarm, and shall terminate the call after alarm reporting is complete. System shall be

capable of multiple retries and buffer alarms until a connection is made. If no connection is made, system

shall attempt connection to an alternate mobile device. System shall also be able to dial multiple mobile devices upon alarm activation.

5. Alarm Acknowledgment: For alarm priority levels that are directed to a OWS, an indication of alarm receipt shall be displayed immediately regardless of the application is in use at the OWS, and shall remain on the screen until acknowledged by a user having a privilege that allows alarm acknowledgment. Upon acknowledgment, the complete alarm message string (including date, time, and user name of acknowledging operator) shall be stored in a selected file on the BC or CSS.

B. It shall be possible for any operator to receive a summary of all alarms regardless of acknowledgement status; for which a particular recipient is enrolled for notification; based on current event state; based on the particular BACnet event algorithm (e.g., change of value, change of state, out of range, and so on); alarm priority; and notification class.

C. BACnet Alarming Services: All alarms and events shall be implemented using standard BACnet event detection and notification mechanisms. The workstation shall receive BACnet alarm and event notifications from any gateway or BACnet controller in the system and display them to an operator. Either intrinsic reporting or algorithmic change reporting may be used but the intrinsic reporting method is preferred. The workstation shall also log alarms and events, provide a way for an operator with sufficient privilege to acknowledge alarms, and log acknowledgements of alarms. It shall be possible for an operator to receive, at any time, a summary of all alarms that are currently in effect at any site whether or not they have been acknowledged. Operators shall also be able to view and change alarm limits for any alarm at the appropriate access level.

D. Alarm Historical Database: The database shall store all alarms and events object occurrences in an ODBC or an OLE database-compliant relational database. Provide a commercially available ODBC driver or OLE database data provider, which would allow applications to access the data using standard Microsoft Windows data access services.

2.07 TRENDING

A. The software shall display historical data in both a tabular and graphical format. The requirements of this trending shall include the following:

1. Provide trends for all physical points, virtual points and calculated variables.
2. BACnet Trend Objects are preferred but where not possible trend data shall be stored in relational database format as specified in herein under Data Acquisition and Storage.
3. In the graphical format, the trend shall plot at least 4 different values for a given time period superimposed on the same graph. The 4 values shall be distinguishable by using unique colors. In printed form the 4 lines shall be distinguishable by different line symbology. Displayed trend graphs shall indicate the engineering units for each trended value.

4. The sample rate and data selection shall be selectable by the operator.
5. The trended value range shall be selectable by the operator.
6. Where trended values on one table/graph are COV, software shall automatically fill the trend samples between COV entries.

B. Control Loop Performance Trends: Controllers incorporating PID control loops shall also provide high resolution sampling in less than six second increments for verification of control loop performance.

C. Data Buffering and Archiving: Trend data shall be buffered at the BC, and uploaded to hard disk storage when archival is desired. All archived trends shall be transmitted to the CSS. Uploads shall occur based upon a user-defined interval, manual command, or automatically when the trend buffers become full.

D. Time Synchronization: Provide a time master that is installed and configured to synchronize the clocks of all BACnet devices supporting time synchronization. Synchronization shall be done using Coordinated Universal Time (UTC). All trend sample times shall be able to be synchronized. The frequency of time synchronization message transmission shall be selectable by the operator.

2.08 Dynamic Plotting

A. Provide a utility to dynamically plot in real-time at least four (4) values on a given 2-dimensional dynamic plot/graph with at least two Y-axes. At least five (5) dynamic plots shall be allowed simultaneously.

2.09 Data acquisition and Storage

A. All points included in the typical equipment point list must be represented in a common, open or accessible format. All points should be provided as BACnet standard analog, binary, schedule, or trend objects when possible. Naming conventions for these points and network addressing are discussed in the 'Point Naming Conventions' paragraph below.

B. Non-BACnet data from the BAS shall be stored in relational database format. The format and the naming convention used for storing the database files shall remain consistent across the database and across time. The relational structure shall allow for storage of any additional data points, which are added to the BAS in future. The metadata/schema or formal descriptions of the tables, columns, domains, and constraints shall be provided for each database.

C. The database shall allow applications to access the data while the database is running. The database shall not require shutting down in order to provide read-write access to the data. Data shall be able to be read from the database without interrupting the continuous storage of trend data being carried by the BAS.

D. The database shall be ODBC or OLE database compliant. Provide a commercially-available ODBC driver or OLE database data provider, which would allow applications to access the data using standard Microsoft Windows data access services.

2.10 TOTALIZATION

A. The software shall support totalizing analog, digital, and pulsed inputs and be capable of accumulating, storing, and converting these totals to engineering units used in the documents. These values shall generally be accessible to the Operator Interfaces to support
management-reporting functions.

B. Totalization of electricity use/demand shall allow application of totals to different rate periods, which shall be user definable.

C. When specified to provide electrical or utility Use/Demand, the Contractor shall obtain from the local utility all information required to obtain meter data, including k factors, conversion constants, and the like.

2.11 EQUIPMENT SCHEDULING

A. Provide a graphic utility for user-friendly operator interface to adjust equipment-operating schedules.

B. All schedules shall be implemented using BACnet objects and messages. All building systems with date and time scheduling requirements shall have schedules represented by the BACnet Schedule object. All operators shall be able to view the entries for a schedule. Operators with sufficient privilege shall be able to modify schedule entries from any BACnet workstation.

C. Scheduling feature shall include multiple seven-day master schedules, plus holiday schedule, each with start time and stop time. Master schedules shall be individually editable for each day and holiday.

D. Scheduling feature shall allow for each individual equipment unit to be assigned to one of the master schedules.

E. Timed override feature shall allow an operator to temporarily change the state of scheduled equipment. An override command shall be selectable to apply to an individual unit, all units assigned to a given master schedule, or to all units in a building. Timed override shall terminate at the end of an operator selectable time, or at the end of the scheduled occupied/unoccupied period, whichever comes first. A privilege level that does not allow assignment of master schedules shall allow a timed override feature.

F. A yearly calendar feature shall allow assignment of holidays, and automatic reset of system real time clocks for transitions between daylight savings time and standard time.

2.12 Point structuring and naming

A. General: The intent of this section is to require a consistent means of naming points across all State facilities. Contractor shall configure the systems from the perspective of the Enterprise, not solely the local project. The following requirement establishes a standard for naming points and addressing Buildings, Networks, Devices, Instances, and the like. The convention is tailored towards the BACnet-based format and as such, the interface shall

always use this naming convention. Native BACnet systems shall also use this naming convention. For
non-BACnet systems, the naming convention shall be implemented as much as practical, and any deviations from this naming convention shall be approved by the State. The Contractor shall contact the State to determine the Building number and abbreviation.

B. Point Summary Table
1. The term 'Point' is a generic description for the class of object represented by analog and binary inputs, outputs, and values in accordance with ASHARE 135 standard.
2. With each schematic, Contractor shall provide a Point Summary Table listing:
   a. Building number and
   abbreviation b. System type
   c. Equipment type
   d. Point suffix
   e. Full point name (see Point Naming Convention paragraph)
   f. Point description
   g. Ethernet backbone network
   number h. Network number
   i. Device ID
   j. Device MAC address
   k. Object ID (object type, instance number)
   l. Engineering units.
3. Additional fields for non-BACnet systems shall be appended to each row. Point Summary Table shall be provided in both hard copy and in electronic format (ODBC-compliant).
4. Point Summary Table shall also illustrate Network Variables/BACnet Data Links Bindings.
5. The Contractor shall coordinate with the State's representative and compile and submit a proposed Point Summary Table for review prior to any object programming or project startup.
6. The Point Summary Table shall be kept current throughout the duration of the project by the Contractor as the Master List of all points for the project. Project closeout documents shall include an up-to-date accurate Point Summary Table. The Contractor shall deliver to the State the final Point Summary Table prior to Substantial Completion of the system. The Point Summary Table shall be used as a reference and guide during the commissioning process.
7. The Point Summary Table shall contain all data fields on a single row per point. The Point Summary Table is to have a single master source for all point information in the building that is easily sorted and kept up-to-date. Although a relational database of Device
   ID-to-point information would be more efficient, the single line format is required as a single master table that will reflect all point information for the building. The point description shall be an easily understandable English-language description of the point.

Point Summary Table Example
Row Headers and Examples
(Transpose for a single point per row format)

Campus	RK
Building Number	006
Building Association	ZZ = no association (default to
ZZ) System Type	Cooling
Equipment Type	Chiller
Point Suffix	CHLR1KW
*Point Name (Object Name)	CA0006ZZ.COOLING.CHILLER.CHLR1KW
*Point Description (Object Description)	Chiller 1
kW Ethernet Network Number	600
Network Number	610
Device ID	1024006
Device MAC address	24
Object Type	AI
Instance Number	4
Engineering Units	KW
Network Variable?	True
Server Device	1024006
Client Devices	1028006
Included with Functional	

*Represents information that shall reside in the relevant BACnet property for the object

C. Point Naming Convention
1. All point names shall adhere to the format as established below. Said objects shall include all physical I/O points, calculated points used for standard reports, and all application program parameters. For each BAS object, a specific and unique BACnet object name shall be required.
2. For each point, four (4) distinct descriptors shall be linked to form each unique object name: Building, System, Equipment, and Point. Use alphanumeric characters. Space and special characters are not allowed. Each of the four descriptors must be bound by a period to form the entire object name. Reference the paragraphs below for an example of these descriptors.
3. The State shall designate the Building descriptor. The System descriptor shall further define the object in terms of air handling, cooling, heating, or other system. The

Equipment descriptor shall define the equipment category; e.g., Chiller, Air Handler, or other equipment. The Point descriptor shall define the hardware or software type or function associated with the equipment; e.g., supply temperature, water pressure, alarm, mixed air temperature setpoint, etc. and shall contain any numbering conventions for multiples of equipment; e.g., CHLR1KW, CHLR2KW, BLR2AL (Boiler 2 Alarm), HWP1ST (Hot Water Pump 1 Status).

4. A consistent object (point) naming convention shall be utilized to facilitate familiarity and operational ease across the BAS network. Inter-facility consistency shall be maintained to ensure transparent operability to the greatest degree possible. The table below details the object naming convention and general format of the descriptor string. BACnet Object Name Requirements

Descriptors		Comment
Campus, Building Number & Building Association	RK0006ZZ AZ0134ZZ	The Master Building List also has the correct abbreviations for each building.
System	AIRHANDLING - EXHAUST - HEATING - COOLING - UTILITY - ENDUSE - MISC	Boilers and ancillary equipment Chillers and ancillary equipment Main electrical and gas meters Specific building loads by type
Equipment	BOILERS - CHILLERS - FACILITY - TOWERS - WEATHER	Non-specific boiler system points - Non-specific chiller system points
Point Suffix	See Input/Output point summary table for conventions	

5. Examples: Within each object name, the descriptors shall be bound by a period. Within each descriptor, words shall not be separated by dashes, spaces, or other separators as follows:
   a. RK0006ZZ.COOLING.CHILLERS.CHWP1ST
   b. RK0006ZZ.HEATING.BOILERS.BLR1CFH

D. Device Addressing Convention:
   1. BACnet network numbers and Device Object IDs shall be unique throughout the network.
   2. All assignment of network numbers and Device Object IDs shall be coordinated with the State.
   3. Each Network number shall be unique throughout all facilities and shall be assigned in the following manner unless specified otherwise:
      a. BBBFF, where: BBB = 1-655 assigned to each building, FF = 00 for building backbone network, 1-35 indicating floors or separate systems in the building.
   4. Each Device Object Identifier property shall be unique throughout the system and shall be assigned in the following manner unless specified otherwise:
      a. XXFFBBB, where: XX = number 0 to 40, FF = 00 for building backbone network, 1-35 indicating floors or separate systems in the building. BBB = 1-655 assigned to each building.
   5. The BAS Contractor shall coordinate with designated State representative to ensure that no duplicate Device Object IDs occur.
   6. Alternative Device ID schemes or cross project Device ID duplication if allowed shall be approved before project commencement by the State.

2.13 OPERATOR INTERFACE GRAPHIC SOFTWARE

A. Graphic software shall facilitate user-friendly interface to all aspects of the System Software specified above. The intent of this specification is to require a graphic package that provides for intuitive operation of the systems without extensive training and experience. It shall facilitate logical and simple system interrogation, modification, configuration, and diagnosis.

B. Graphic software shall support multiple simultaneous screens to be displayed and resizable in a web-based environment. All functions excepting text entry functions shall be executable with a mouse.

C. Graphic software shall display current operating mode (i.e. warm-up, dehumidification, et al) for equipment with multiple modes of operation.

D. Graphic software shall provide for multitasking such that other application can be used while the operator is accessing the BAS. Software shall provide the ability to alarm graphically even

when operator is in another software package.

E. The software shall be compatible to the current and current minus one versions of

Microsoft Windows operating system. The software shall allow for the State's creation of user-defined, color graphic displays of geographic maps, building plans, floor plans, and mechanical and electrical system schematics. These graphics shall be capable of displaying all point information from the database including any attributes associated with each point (i.e., engineering units, etc.). In addition, operators shall be able to command equipment or change setpoints from a graphic through the use of a pointing device; e.g. mouse and touch screen.

F. Screen Penetration: The operator interface shall allow users to access the various system graphic screens via a graphical penetration scheme by using the pointing device to select from menus or 'button' icons. Each graphic screen shall be capable of having a unique list of other graphic screens that are directly linked through the selection of a menu item or button icon.

G. Dynamic Data Displays: Dynamic physical point values shall automatically updated at a minimum frequency of 6 updates per minute without operator intervention. Point value fields shall be displayed with a color code depicting normal, abnormal, override and alarm conditions.

H. Point Override Feature: Each displayed point shall be individually enabled/disabled to allow pointing device driven override of digital points or changing of analog points. Such overrides or changes shall occur in the control unit, not just in the BAS software. The graphic point override feature shall be subject to privilege level protection. Points that are overridden shall be reported as an alarm, and shall be displayed in a coded color. The alarm message shall include the operator's login name. A list of points that are currently in an override state shall be available through menu selection and include the time/date of the override along with the operator's login name that initiated that override.

I. Dynamic Symbols: Provide a selection of standard symbols that change in appearance based on the value of an associated point.
   1. Analog symbol: Provide a symbol that represents the value of an analog point as the length of a line or linear bar.
   2. Digital symbol: Provide symbols such as switches, pilot lights, rotating fan wheels, etc. to represent the value of digital input and output points.
   3. Point Status Color: Graphic presentations shall indicate different colors for different point statuses. (For instance, green = normal, red = alarm, gray (or '???') for non-response.

J. Graphics Development Package: Graphic development and generation software shall be provided to allow the user to add, modify, or delete system graphic displays.
   1. The Contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g. fans, cooling coils, filters, dampers, etc.), mechanical system components (e.g., pumps, chillers, cooling towers, boilers, etc.), complete mechanical systems (e.g. constant volume-terminal reheat, VAV, etc.) and electrical symbols.

2. The Graphic Development Package shall use a pointing device to allow the user to perform the following:
   a. Define symbols
   b. Position items on graphic screens
   c. Attach physical or virtual points to a graphic
   d. Define background screens
   e. Define connecting lines and curves
   f. Locate, orient and size descriptive text
   g. Define and display colors for all elements
   h. Establish correlation between symbols or text and associated system points or other displays
   i. Create hot spots or link triggers to other graphic displays or other functions in the software

K. Graphic images shall reside on the CSS.

L. The software shall be capable of initiating communication between the BC and the CSS:
   1. Upon user command, to perform all specified functions.
   2. In accordance with user-programmed time schedules to report alarms and upload trend and report data to the CSS.

M. The software shall automatically terminate the communication when all specified functions are completed.

PART 3 - EXECUTION

3.01 SYSTEM CONFIGURATION

A. Contractor shall thoroughly and completely configure BAS system software, supplemental software, network communications, BC and CSS, if necessary .

3.02 SITE-SPECIFIC APPLICATION PROGRAMMING

A. Provide all database creation and site-specific application control programming as required by these Specifications, national and local standards and for a fully functioning system. Contractor shall provide all initial site-specific application programming and thoroughly document programming. Generally meet the intent of the written sequences of operation. It is the Contractor's responsibility to request clarification on sequence issues that require such clarification.

B. All site-specific programming shall be fully documented and submitted for review and approval, both prior to downloading into the panel, at the completion of functional performance testing, and at the end of the warranty period.

C. All programming, graphics and data files must be maintained in a logical system of directories with self-explanatory file names. All files developed for the project will be the property of the State and shall remain on the BC and CSS at the completion of the project.

3.03 PRIVILEGE LEVELs SETUP

A. Set up the following privilege levels to include the specified capabilities:
   1. Level 1: (State's BAS Administrator)
      a. Level 2 capabilities
      b. Configure system software
      c. Modify graphic software
      d. View, add, change and delete user login credentials and privilege levels
      e. All unrestricted system capabilities including all network management functions.
   2. Level 1a (Contractor Technician)
      a. Level 2 capabilities
      b. Configure system software
      c. Modify graphic software
   3. Level 2: (Maintenance Manager)
      a. Level 3 capabilities
      b. Modify control unit programs
   4. Level 3: (Senior BAS Technician)
      a. Level 4 capabilities
      b. Override output points
      c. Change setpoints
      d. Change equipment schedules
   5. Level 4: (Junior BAS Technician and Trainee)
      a. Level 5 capabilities
      b. Acknowledge alarms
      c. Temporarily override equipment schedules
   6. Level 5: (Read Only)
      a. Display all graphic
      data b. Trend point data

B. Contractor shall assist:
   1. State's BAS Administrator with assigning user login credentials and privilege levels, configure system software and modify graphic software.
   2. Maintenance Manger with modifying control unit programs.

3.04 POINT PARAMETERS

A. Provide the following minimum programming for each analog input:
   1. Name
   2. Address
   3. Scanning frequency or COV threshold
   4. Engineering units
   5. Offset calibration and scaling factor for engineering units
   6. High and low alarm values and alarm differentials for return to normal condition
   7. High and low value reporting limits (reasonableness values), which shall prevent control logic from using shorted or open circuit values.

8. Default value to be used when the actual measured value is not reporting. This is required only for points that are transferred across the primary and/or secondary controlling networks and used in control programs residing in control units other than the one in which the point resides. Events causing the default value to be used shall include failure of the control unit in which the point resides, or failure of any network over which the point value is transferred.
9. Selectable averaging function that shall average the measured value over a user selected number of scans for reporting.

B. Provide the following minimum programming for each analog output:
1. Name
2. Address
3. Output updating frequency
4. Engineering units
5. Offset calibration and scaling factor for engineering units
6. Output Range
7. Default value to be used when the normal controlling value is not reporting.

C. Provide the following minimum programming for each digital input:
1. Name
2. Address
3. Engineering units (on/off, open/closed, freeze/normal, etc.)
4. Debounce time delay
5. Message and alarm reporting as specified
6. Reporting of each change of state, and memory storage of the time of the last change of state
7. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions.

D. Provide the following minimum programming for each digital output:
1. Name
2. Address
3. Output updating frequency
4. Engineering units (on/off, open/closed, freeze/normal, etc.)
5. Direct or Reverse action selection
6. Minimum on-time
7. Minimum off-time
8. Status association with a DI and failure alarming (as applicable)
9. Reporting of each change of state, and memory storage of the time of the last change of state.
10. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions.
11. Default value to be used when the normal controlling value is not reporting.

3.05 Trends

A. Contractor shall establish and store trend logs. Trend logs shall be prepared for each physical input and output point, and all dynamic virtual points such as setpoints subject to a reset schedule, intermediate setpoint values for cascaded control loops, and the like as directed by the State.

B. The State will analyze trend logs of the system operating parameters to evaluate normal system functionality. Contractor shall establish these trends and ensure they are being stored properly.

1. Data shall include a single row of field headings and the data thereafter shall be contiguous. Each record shall include a date and time field or single date stamp.

   Recorded parameters for a given piece of equipment or component shall be trended at the same intervals and be presented in a maximum of two separate 2-dimensional formats with time being the row heading and field name being the column heading.

C. Sample times indicated as COV (±) or change-of-value mean that the changed parameter only needs to be recorded after the value changes by the amount listed. When output to the trending file, the latest recorded value shall be listed with any given time increment record. The samples shall be filled with the latest values also if the points include different time intervals. If the BAS does not have the capability to record based on COV, the parameter shall be recorded based on the interval common to the unit.

D. Trending intervals or COV thresholds shall be dictated by the State upon system start-up.

E. The Contractor shall demonstrate functional trends as specified for a period of 30 days after successful system demonstration before Substantial Completion of the system.

3.06 TREND GRAPHS

A. Prepare controller and graphic software to display graphical format trends. Trended values and intervals shall be the same as those specified.

B. Lines shall be labeled and shall be distinguishable from each other by using either different line types, or different line colors.

C. Indicate engineering units of the y-axis values; e.g. degrees F., inches w.g., Btu/lb, percent open, etc.

D. The y-axis scale shall be chosen so that all trended values are in a readable range. Do not mix trended values on one graph if their unit ranges are incompatible.

E. Trend outside air temperature, humidity, and enthalpy during each period in which any other points are trended.

F. All points trended for one subsystem (e.g. air handling unit, chilled water system, etc.) shall be trended during the same trend period.

G. Each graph shall be clearly labeled with the subsystem title, date, and times.

3.07 ALARMS

A. Override Alarms: Any point that is overridden through the override feature of the graphic software shall be reported as a Level 3 alarm.

B. Analog Input Alarms: For each analog input, program an alarm message for reporting whenever the analog value is outside of the programmed alarm limits. Report a 'Return-to-Normal' message after the analog value returns to the normal range, using a programmed alarm differential. The alarm limits shall be individually selected by the Contractor based on the following criteria:

1. Space temperature, except as otherwise stated in sequence of operation: Level 3
   a. Low alarm: 64°F
   b. Low return-to-normal: 68°F
   c. High alarm: 85°F
   d. High return-to-normal: 80°F
2. Controlled media temperature other than space temperature (e.g. AHU discharge air temperature, steam converter leaving water temperature, condenser water supply, chilled water supply, etc.): Level 3 (If controlled media temperature setpoint is reset, alarm setpoints shall be programmed to follow setpoint)
   a. Low alarm: 3°F below setpoint
   b. Low return-to-normal: 2°F below setpoint
   c. High alarm: 3°F above setpoint
   d. High return-to-normal: 2°F above setpoint.
3. AHU mixed air temperature: Level 4
   a. Low alarm: 45°F
   b. Low return-to-normal: 46°F
   c. High alarm: 90°F
   d. High return-to-normal: 89°F
4. Duct Pressure:
   a. Low alarm: 0.5”w.g. below setpoint
   b. Low return-to-normal: 0.25”w.g. below setpoint
   c. High alarm: 0.5”w.g. above setpoint
   d. High return-to-normal: 0.25”w.g. above setpoint
5. Space humidity:
   a. Low alarm: 35%
   b. Low return-to-normal: 40%
   c. High alarm: 75%
   d. High return-to-normal: 70%

C. HOA Switch Tampering Alarms: The Sequences of Operation are based on the presumption that motor starter Hand-Off-Auto (HOA) switches are in the 'Auto' position. [If a motorized equipment unit starts without a prior start command from the FMS, (as sensed by status sensing device), then FMS shall perform the remaining sequence as

specified.] BAS shall also enunciate the following Level 5 alarm message if status indicates a unit is operational when the run command is not present:

1. DEVICE XXXX FAILURE: Status is indicated on the device even though it has been commanded to stop. Check the HOA switch, control relay, status sensing device, contactors, and other components involved in starting the unit. Acknowledge this alarm when the problem has been corrected.

D. Maintenance Alarms: Enunciate Level 5 alarms when runtime accumulation exceeds a value specified by the operator

1. DEVICE XXXX REQUIRES MAINTENANCE. Runtime has exceeded specified value since last reset.

E. See requirements for additional equipment-specific alarms specified in Section 23 09 59 - Sequences of Operation.

3.08 GRAPHIC SCREENS

A. Floor Plan Screens: The contract document drawings will be made available to the Contractor in AutoCAD (current version) format upon request. These drawings may be used only for developing backgrounds for specified graphic screens; however the State does not guarantee the suitability of these drawings for the Contractor's purpose.

1. Provide graphic floor plan screens for each [floor] [wing] [tower] [other] of the building. Indicate the location of all equipment that is not located on the equipment room screens. Indicate the location of temperature sensors associated with each temperature-controlled zone (i.e., VAV terminals, fan-coils, single-zone AHUs, etc.) on the floor plan screens. [Zone background color shall change based on the temperature offset from setpoint]. Display the space temperature point adjacent to each temperature sensor symbol. Use a distinct line symbol to demarcate each terminal unit zone boundary. Use distinct colors to demarcate each air handling unit zone. [Mechanical floor plan drawings will be made available to the contractor upon request for the purpose of determining zone boundaries.] Indicate room numbers as provided by the State. Provide a drawing link from each space temperature sensor symbol and equipment symbol shown on the graphic floor plan screens to each corresponding equipment schematic graphic screen.
2. Provide graphic floor plan screens for each mechanical equipment room and a plan screen of the roof. Indicate the location of each item of mechanical equipment. Provide a drawing link from each equipment symbol shown on the graphic plan view screen to each corresponding mechanical system schematic graphic screen.
3. If multiple floor plans are necessary to show all areas, provide a graphic building key plan.

   Use elevation views and/or plan views as necessary to graphically indicate the location of all of the larger scale floor plans. Link graphic building key plan to larger scale partial floor plans. Provide links from each larger scale graphic floor plan screen to the building key plan and to each of the other graphic floor plan screens.
4. Provide a graphic site plan with links to and from each building plan.

B. System Schematic Screens: Provide graphic system schematic screen for each subsystem controlled with each I/O point in the project appearing on at least one graphic screen. System graphics shall include flow diagrams with status, setpoints, current analog input and output values, operator commands, etc. as applicable. General layout of the system shall be schematically correct. Input/output devices shall be shown in their schematically correct locations. Include appropriate engineering units for each displayed point value. Verbose names (English language descriptors) shall be included for each point on all graphics; this may be accomplished by the use of a hover box when the operator moves the cursor over the displayed point. Indicate all adjustable setpoints on the applicable system schematic graphic screen or, if space does not allow, on a supplemental linked-setpoint screen.

1. Provide graphic screens for each air handling system. Indicate outside air temperature and enthalpy, and mode of operation as applicable (i.e., occupied, unoccupied, warm-up,
cool-down). Link screens for air handlers to the heating system and cooling system graphics. Link screens for supply and exhaust systems if they are not combined onto one screen.
2. Provide a graphic screen for each zone. Provide links to graphic system schematic screens of air handling units that serve the corresponding zone.
3. Provide a cooling system graphic screen showing all points associated with the chillers, cooling towers and pumps. Indicate outside air dry-bulb temperature and calculated
wet-bulb temperature. Link screens for chilled water and condenser water systems if they cannot fit onto one cooling plant graphic screen.
4. Link screens for heating and cooling system graphics to utility history reports showing

current and monthly electric uses, demands, peak values, and other pertinent values.

C. Bar Chart Screens: On each graphic Bar Chart Screen, provide drawing links to the graphic air handling unit schematic screens.

1. Provide a graphic chilled water valve screen showing the analog output signal of all chilled water valves in a bar chart format, with signals expressed as percentage of fully open valve (percentage of full cooling). Indicate the discharge air temperature and setpoint of each air handling unit, cooling system chilled water supply and return temperatures and the outside air temperature and humidity on this graphic. Provide drawing links between the graphic cooling plant screen and this graphic screen.
2. Provide a graphic heating water valve screen showing the analog output signal of all air handling unit heating water valves in a bar chart format, with signals expressed as percentage of fully open valve (percentage of full heating). Indicate the temperature of the controlled medium (such as AHU discharge air temperature or zone hot water supply temperature) and the associated setpoint and the outside air temperature and humidity.

D. Alarms: Each programmed alarm shall appear on at least one graphic screen. In general, alarms shall be displayed on the graphic system schematic screen for the system that the alarm is associated with (for example, chiller alarm shall be shown on graphic cooling

system schematic screen). For all graphic screens, display analog values that are in a 'high alarm' condition in a red color, 'low alarm' condition in a blue color. Indicate digital values that are in alarm condition in a red color.

END OF SECTION 23 09 55

SECTION 23 09 58 - BAS SEQUENCE OF OPERATION

PART 1 - GENERAL

1.01 Section Includes

A. Air Handling Units

B. Chilled Water System

C. Terminal Units

D. Exhaust Fans

1.02 Related Documents:

A. Section 23 09 50 - Building Automation System (BAS) General

B. Section 23 09 51 - BAS Basic Materials, Interface Devices, and Sensors

C. Section 23 09 53 - BAS Field Panels

D. Section 23 09 54 - BAS Communications Devices

E. Section 23 09 55 - BAS Software

F. Section 23 09 59 - BAS Commissioning

1.03 System Description

A. The systems to be controlled under work of this section basically comprise (describe the scope of the project). The systems being controlled are (describe the configuration of and the type of systems included in the project).

B. This Section defines the manner and method by which controls function.

1.04 Submittals

A. Refer to Section 23 09 50 and Division 1 for requirements for control shop drawings, product data, User Manual, etc.

B. Programming Manual: Provide BAS system programming manual as well as documentation of site-specific programming prior to the start of Acceptance Phase.

1.05 Project Record Documents

A. Within two weeks of the completion of commissioning, provide record documents to represent the final control configuration with actual setpoints and tuning parameters as existed at acceptance.

B. Record documents shall be modified control drawings with the actual installed information. Drawings shall be delivered in both reproducible hard copy and electronic format in

AutoCAD (current version) drawing files. Provide all supporting files, blocks, fonts, etc. required by the drawings.

C. Provide final points list as described above.

D. Provide final detailed wiring diagrams with all wire numbers and termination points indicated. E. Accurately record final sequences and control logic made after submission of shop drawings.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

A. Sequences specified herein indicate the functional intent of the systems operation and may not fully detail every aspect of the programming that may be required to obtain the indicated operation. Contractor shall provide all programming necessary to obtain the sequences/system operation indicated.

B. For Sequence of Operations for all HVAC equipment, refer to Sheet M601.

3.02 Demand Limiting Control:

A. BAS shall monitor kW demand over a 15-minute sliding window period.

B. Demand limiting shall be disabled during the winter billing period. When demand limiting is enabled, it shall be possible for the operator to disable it on a daily basis, but it shall be automatically re-enabled each day at 12 midnight.

C. On a rise in kW to within [200] kW (adj.) of setpoint, a Level 4 alarm shall be enunciated and BAS shall begin to make one “load shed” command every [3] minutes (adj.). On a fall in kW to [200] kW less than the demand setpoint, BAS shall begin to broadcast one ”load restore” command every [3] (adj.) minutes on a first shed, first restored basis. If demand exceeds the demand setpoint and there are no more loads left to shed, the demand setpoint shall be increased to the maximum demand experienced. Demand setpoint shall be automatically reset to an adjustable value at the beginning of each billing period.

D. “Loads” available for shedding are defined elsewhere in this specification section.

E. On a rise in kW to within [50] kW (adj.) of setpoint, a Level 3 and Level 4 alarm shall be enunciated.

3.03 Central plant equipment - MONITORING AND MANAGEMENT

A. General: The BAS shall monitor various aspects of the heating and cooling systems and calculate parameters as specified below to facilitate plant operations and management.

B. Trending: The BAS shall continuously monitor, calculate and display the following parameters at the intervals indicated. These values shall be stored and reported per the trending requirements defined in Section 23 09 55.

C. Parameters to be trended:

1. Load on the secondary systems in MBH per the following equation: (Return Temp-Supply Temp) * (GPM) / .5. This shows cooling as a positive heat load and heating as a negative heat load. Note that multipliers on this value to accommodate the BAS processors are acceptable as long as they are clearly indicated. This value shall be trended and stored every two hours.
2. All temperature sensors at 1 hour intervals
3. All relative humidity sensors at 1 hour intervals
4. All pressure sensors at 1 hour intervals
5. All run requests and statuses on a change in value
6. All analog loop outputs on 1 hour intervals
7. Calculated enthalpies in 2 hour intervals
8. Summed cooling and heating requests on 2 hour intervals

END OF SECTION 23 09 58

SECTION 23 09 59 - BAS SYSTEM COMMISSIONING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. BAS and equipment testing and start-up

B. Validation of proper and thorough installation of BAS and equipment

C. Functional testing of control systems

D. Documentation of tests, procedures, and installations

E. Coordination of BAS training

F. Documentation of BAS Operation and Maintenance materials

1.02 RELATED SECTIONS:

A. Section 23 09 50 - BAS General Requirements

B. Section 23 09 51 - BAS Basic Materials and Devices

C. Section 23 09 53 - BAS Field Panels

D. Section 23 09 54 - BAS Communication Devices

E. Section 23 09 55 - BAS Software and Programming

F. Section 23 09 58 - Sequence of Operation

1.03 GENERAL DESCRIPTION

A. This section defines responsibilities of the Controls Contractor to commission the BAS.

B. The Government, at Government's expense, shall retain a Commissioning Authority (CA) who shall work with the Contractor to ensure that the systems, equipment, and interfaces are installed, tested, and operate per the design intent; that the systems are adequately documented; and that the Government is adequately trained on system intent, operation, and maintenance.

The following is written based on the use of a separate Commissioning Authority (CA). If that is not the case on the project, the Contractor must still start up and commission the BAS. Therefore edit the responsibilities as appropriate for the project commissioning requirements.

1.04 CONTRACTOR RESPONSIBILITIES

A. Completely install and thoroughly inspect, startup, test, adjust, balance, and document all systems and equipment.

B. Assist Commissioning Authority in performing verification and performance testing. This will generally include the following:
   1. Attend Commissioning (Cx) progress and coordination meetings.
   2. Prepare and submit required draft forms and systems information.
   3. Establish trend logs of system operation as specified herein.
   4. Demonstrate system operation.
   5. Manipulate systems and equipment to facilitate testing.
   6. Provide instrumentation necessary for verification and performance testing.
   7. Manipulate control systems to facilitate verification and performance testing.
   8. Train State's Representatives as specified in Part III of this section.

C. Provide a BAS Technician to work at the direction of Commissioning Authority for software optimization assistance for a minimum of [80] hours. Refer to Part 3 for a description of the software optimization.

1.05 SEQUENCING

A. The following list outlines the general sequence of events for submittals and
   1. commissioning: Submit product data and shop drawings, and receive approval.
   2. Submit BAS logic documentation, and receive approval.
   3. Submit Start-Up Checklists and manufacturer's start-up procedures for all equipment provided by the BAS Contractor.
   4. Install BAS
   5. Submit BAS Start-Up Test Agenda and Schedule for review.
   6. Receive BAS start up Test Agenda/schedule approval.
   7. Submit Training Plan.
   8. Simulate sequencing and debug program off-line to the extent practical.
   9. Place systems under BAS control where applicable during a scheduled outage.
   10. Perform BAS start up where applicable during a scheduled outage.
   11. Prepare and initiate trend log data storage and format trend graphs.
   12. Submit completed BAS Start-Up Reports and initial draft of the O&M Manuals.
   13. Receive BAS Start Up Report approval and approval to schedule Demonstrations Commissioning.
   14. Demonstrate systems to Commissioning Authority and The State.
   15. Submit Trend Logs in format specified.
   16. Receive demonstration approval and approval to schedule Acceptance Period.
   17. Train The State on BAS operation and maintenance.
   18. Substantial Completion.
   19. Begin Acceptance Phase.
   20. Two week Operational Test.
   21. Perform Functional Performance Testing.
   22. Receive Acceptance Period approval, which is Functional Completion for the BAS.
   23. Train The State on final sequences and modes of operation.
   24. Install framed control drawings. (See Section 23 09 50/1.09/G)
   25. Provide Level 1 password access to the State.
   26. Revise and re-submit record drawings and O&M Manuals.
   27. Substantial Completion.

28. Begin Warranty Phase.
29. Schedule and begin Opposite Season acceptance period.
30. Receive Opposite Season acceptance period approval.
31. Submit as-built drawings and O&M Manuals.
32. Update framed control drawings. (See Section 23 09 50/1.09/G)
33. Complete State personnel Training.
34. End-of-Warranty date/period.

PART 2 - PRODUCTS

2.01 INSTRUMENTATION

A. Instrumentation required to verify readings and test the system and equipment performance shall be provided by Contractor and made available to Commissioning Authority. Generally, no
testing equipment will be required beyond that required to perform Contractors work under these Contract Documents. All equipment used for testing and calibration shall be NIST/NBS traceable and calibrated within the preceding 6-month period. Certificates of calibration shall be submitted.

2.02 TAB & COMMISSIONING Portable operators terminal

A. For new projects, Contractor shall provide a portable operators terminal or hand held device to facilitate Testing, Adjusting, and Balancing (TAB) and calibration. This device shall support all functions and allow querying and editing of all parameters required for proper calibration and start up.

B. Connections shall be provided local to the device being calibrated. For instance, for VAV boxes, connection of the operator's terminal shall be either at the sensor or at the terminal box. Otherwise a wireless system shall be provided to facilitate this local functionality.

PART 3 - EXECUTION

3.01 BAS Start-Up TESTING, ADJUSTING, CALIBRATION

A. Work and/or systems installed under this Division shall be fully functioning prior to Demonstration and Acceptance Phase. Contractor shall start, test, adjust, and calibrate all work and/or systems under this Contract, as described below:
   1. Inspect the installation of all devices. Review the manufacturer's installation instructions and validate that the device is installed in accordance with them.
   2. Verify proper electrical voltages and amperages, and verify that all circuits are free from faults.
   3. Verify integrity/safety of all electrical connections.
   4. For the following control settings, initially use the control setting that was used by existing control system, unless otherwise indicated. For AHUs that use a throttled

outside air damper position when minimum outside air is required, contractor shall mark existing minimum outside air damper position to allow replication by new controls.

5. Coordinate with TAB subcontractor to obtain control settings that are determined from balancing procedures. Record the following control settings as obtained from TAB contractor, and note any TAB deficiencies in the BAS Start-Up Report:
   a. Optimum duct static pressure setpoints for VAV air handling units.
   b. Minimum outside air damper settings for air handling units.
   c. Optimum differential pressure setpoints for variable speed pumping systems.
   d. Calibration parameters for flow control devices such as VAV boxes and flow measuring stations.
      1) BAS contractor shall provide hand-held device as a minimum to the TAB and CA to facilitate calibration. Connection for any given device shall be local to it (i.e. at the VAV box or at the thermostat). Hand-held device or portable operator's terminal shall allow querying and editing of parameters required for proper calibration and start-up.
6. Test, calibrate, and set all digital and analog sensing and actuating devices. Calibrate each instrumentation device by making a comparison between the BAS display and the reading at the device, using an instrument traceable to the National Bureau of Standards, which shall be at least twice as accurate as the device to be calibrated (e.g., if field device is +/-0.5% accurate, test equipment shall be +/-0.25% accurate over same range). Record the measured value and displayed value for each device in the BAS Start Up Report.
7. Check and set zero and span adjustments for all transducers and transmitters.
8. For dampers and valves:
   a. Check for adequate installation including free travel throughout range and adequate seal.
   b. Where loops are sequenced, check for proper control without overlap.
9. For actuators:
   a. Check to insure that device seals tightly when the appropriate signal is applied to the operator.
   b. Check for appropriate fail position, and that the stroke and range is as required.
   c. For pneumatic operators, adjust the operator spring compression as required to achieve close-off. If positioner or volume booster is installed on the operator, calibrate per manufacturer's procedure to achieve spring range indicated. Check split-range positioners to verify proper operation. Record settings for each device in the BAS Pre-Commissioning Report.
   d. For sequenced electronic actuators, calibrate per manufacturer's instructions to required ranges.

10. Check each digital control point by making a comparison between the control command at the CU and the status of the controlled device. Check each digital input point by making a comparison of the state of the sensing device and the Operator Interface display. Record the results for each device in the BAS Start-Up Report.
11. For outputs to reset other manufacturer's devices (for example, VSDs) and for feedback from them, calibrate ranges to establish proper parameters. Coordinate with representative of the respective manufacturer and obtain their approval of the installation.
12. Verify proper sequences by using the approved checklists to record results and submit with BAS Start-Up Report. Verify proper sequence and operation of all specified functions.
13. Verify that all safety devices trip at appropriate conditions. Adjust setpoints accordingly.
14. Tune all control loops to obtain the fastest stable response without hunting, offset or overshoot. Record tuning parameters and response test results for each control loop in the BAS Start Up Report. Except from a startup, maximum allowable variance from set point for controlled variables under normal load fluctuations shall be as follows. Within 3 minutes of any upset (for which the system has the capability to respond) in the control loop, tolerances shall be maintained (exceptions noted):
    a. Duct air temperature: ±1°F.
    b. Space Temperature: ±2°F
    c. Chilled Water: ±1°F
    d. Hot water temperature: ±3°F.
    e. Condenser water temperature: ±3°F.
    f. Duct pressure: ± 0.25” w.g.
    g. Water pressure: ±1 psid
    h. Duct or space Humidity: ±5%
    i. Air flow control: ±5% of setpoint velocity. [For fume hoods ±10% on full sash travel (from min to max in 3 seconds) within 3 seconds. Refer to Section 15995 for fume hood acceptance requirements.] [For minimum OA flow loops being reset from CO2, response to upset max time is one hour.]
    j. Space Pressurization (on active control systems): ±0.05” wg with no door or window movements.
15. For interface and DDC control panels:
    a. Ensure devices are properly installed with adequate clearance for maintenance and with clear labels in accordance with the record drawings.
    b. Ensure that terminations are safe, secure and labeled in accordance with the record drawings.
    c. Check power supplies for proper voltage ranges and loading.
    d. Ensure that wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in trough.

e. Check for adequate signal strength on communication networks.
f. Check for standalone performance of controllers by disconnecting the controller from the LAN. Verify the event is annunciated at Operator Interfaces. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection.
g. Ensure that all outputs and devices fail to their proper positions/states.
h. Ensure that buffered and/or volatile information is held through power outage.
i. With all system and communications operating normally, sample and record update/annunciation times for critical alarms fed from the panel to the Operator Interface.
j. Check for adequate grounding of all DDC panels and devices.

16. For Operator Interfaces:
    a. Verify that all elements on the graphics are functional and are properly bound to physical devices and/or virtual points, and that hot links or page jumps are functional and logical.
    b. Output all specified BAS reports for review and approval.
    c. Verify that the alarm printing and logging is functional and per requirements.
    d. Verify that trends are archiving to disk and provide a sample to the [Commissioning Authority and] State for review.
    e. Verify that paging/dial-out alarm annunciation is functional.
    f. Verify the functionality of remote Operator Interfaces and that a robust connection can be established consistently.
    g. Verify that required third party software applications required with the bid are installed and are functional.
17. Start-up and check out control air compressors, air drying, and filtering systems in accordance with the appropriate section and with manufacturer's instructions.
18. Verify proper interface with fire alarm system.

B. Submit Start-Up Test Report: Report shall be completed, submitted, and approved prior to Substantial Completion.

3.02 Sensor Checkout and Calibration

A. General Checkout: Verify that all sensor locations are appropriate and are away from causes of erratic operation. Verify that sensors with shielded cable are grounded only at one end. For sensor pairs that are used to determine a temperature or pressure difference, make sure they are reading within 0.2°F of each other for temperature and within a tolerance equal to 2% of the reading of each other for pressure. Tolerances for critical applications may be tighter.

B. Calibration: Calibrate all sensors using one of the following procedures:
    1. Sensors Without Transmitters - Standard Application: Make a reading with a calibrated test instrument within 6 inches of the site sensor at various points across the range.

Verify that the sensor reading (via the permanent thermostat, gage or BAS) is within the tolerances specified for the sensor. If not, adjust offset and range, or replace sensor. Where sensors are subject to wide variations in the sensed variable, calibrate sensor within the highest and lowest 20% of the expected range.

2. Sensors With Transmitters - Standard Application: Disconnect sensor. Connect a signal generator in place of sensor. Connect ammeter in series between transmitter and BAS control panel. Using manufacturer's resistance-temperature data, simulate minimum desired temperature. Adjust transmitter potentiometer zero until the ammeter reads 4 mA. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the OI. Record all values and recalibrate controller as necessary to conform to tolerances. Reconnect sensor. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or BAS) is within the tolerances specified. If not, replace sensor and repeat. For pressure sensors, perform a similar process with a suitable signal generator.

C. Sensor Tolerance: Sensors shall be within the tolerances specified for the device. Refer to Section 23 09 51.

3.03 Coil Valve Leak Check

A. Verify proper close-off of the valves. Ensure the valve seats properly by simulating the maximum anticipated pressure difference across the circuit. Calibrate air temperature sensors on each side of coil to be within 0.5°F of each other. Via the Operator Interface, command the valve to close. Energize fans. After 5 minutes, observe air temperature difference across coil. If a temperature difference is indicated, and the piping surface temperature entering the coil is within 3°F of the water supply temp, leakage is probably occurring. If it appears that it is occurring, close the isolation valves to the coil to ensure the conditions change. If they do, this validates the valve is not closing. Remedy the condition by adjusting the stroke and range, increasing the actuator size/torque, replacing the seat, or replacing the valve as applicable.

3.04 Valve Stroke Setup and Check

A. For all valve and actuator positions checked, verify the actual position against the Operator Interface readout.

B. Set pumps to normal operating mode. Command valve closed, verify that valve is closed, and adjust output zero signal as required. Command valve open, verify position is full open and adjust output signal as required. Command the valve to various few intermediate positions. If actual valve position doesn't reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

3.05 BAS DEMONSTRATION

A. Demonstrate the operation of the BAS hardware, software, and all related components and systems to the satisfaction of the Commissioning Authority and State. Schedule the

demonstration with the State's representative 1 week in advance. Demonstration shall not be scheduled until all hardware and software submittals, and the Start-Up Test Report are approved. If the Work fails to be demonstrated to conform with Contract specifications, so as to require scheduling of additional site visits by the Commissioning Authority for re-demonstration, Contractor shall reimburse The State for costs of subsequent Commissioning Authority site visits.

B. The Contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, instruments, ladders, etc. Contractor-supplied personnel must be competent with and knowledgeable of all project-specific hardware, software, and the HVAC systems. All training documentation and submittals shall be at the job site.

C. Demonstration shall typically involve small representative samples of systems/equipment randomly selected by the State and CA.

D. The system shall be demonstrated following the same procedures used in the Start-Up Test by using the approved Commissioning Checklists. Demonstration shall include, but not necessarily be limited to, the following:
   1. Demonstrate that required software is installed on BAS workstations. Demonstrate that graphic screens, alarms, trends, and reports are installed as submitted and approved.
   2. Demonstrate that points specified and shown can be interrogated and/or commanded (as applicable) from all workstations, as specified.
   3. Demonstrate that remote dial-up communication abilities are in accordance with these Specifications.
   4. Demonstrate correct calibration of input/output devices using the same methods specified for the Start-Up Tests. A maximum of 10 percent of I/O points shall be selected at random by the Commissioning Authority and/or State for demonstration. Upon failure of any device to meet the specified end-to-end accuracy, an additional 10 percent of I/O points shall be selected at random by Commissioning Authority for demonstration. This process shall be repeated until 100 percent of randomly selected I/O points have been demonstrated to meet specified end-to-end accuracy.
   5. Demonstrate that all DDC and other software programs exist at respective field panels. The Direct Digital Control (DDC) programming and point database shall be as submitted and approved.
   6. Demonstrate that all DDC programs accomplish the specified sequences of operation.
   7. Demonstrate that the panels automatically recover from power failures, as specified.
   8. Demonstrate that the stand-alone operation of panels meets the requirements of these Specifications. Demonstrate that the panels' response to LAN communication failures meets the requirements of these Specifications.
   9. Identify access to equipment selected by Commissioning Authority. Demonstrate that access is sufficient to perform required maintenance.

10. Demonstrate that required trend graphs and trend logs are set up per the requirements. Provide a sample of the data archive. Indicate the file names and locations.

E. BAS Demonstration shall be completed and approved prior to Substantial Completion.

F. Any tests successfully completed during the demonstration will be recorded as passed for the functional performance testing and will not have to be retested.

3.06 BAS ACCEPTANCE PERIOD

A. After approval of the BAS Demonstration and prior to Contract Close Out Acceptance Phase shall commence. Acceptance Period shall not be scheduled until all HVAC systems are in operation and have been accepted, all required cleaning and lubrication has been completed (i.e., filters changed, piping flushed, strainers cleaned, and the like), and TAB report has been submitted and approved. Acceptance Period and its approval will be performed on a system-by-system basis if mutually agreed upon by the Contractor and the Government.

B. Operational Test: At the beginning of the Acceptance Phase, the system shall operate properly for two weeks without malfunction, without alarm caused by control action or device failure, and with smooth and stable control of systems and equipment in conformance with these specifications. At the end of the two weeks, contractor shall forward the trend logs to the Commissioning Authority for review. Commissioning Authority shall determine if the system is ready for functional performance testing and document any problems requiring contractor attention.

1. If the systems are not ready for functional performance testing, Contractor shall correct problems and provide notification to the State's representative that all problems have been corrected. The Acceptance Period shall be restarted at a mutually scheduled time for an additional one-week period. This process shall be repeated until Commissioning Authority issues notice that the BAS is ready for functional performance testing.

C. During the Acceptance Period, the contractor shall maintain a hard copy log of all alarms generated by the BAS. For each alarm received, Contractor shall diagnose the cause of the alarm, and shall list on the log for each alarm, the diagnosed cause of the alarm, and the corrective action taken. If in the Contractor's opinion, the cause of the alarm is not the responsibility of the Contractor, Contractor shall immediately notify the State's representative.

3.07 Trend Logs

A. Contractor shall configure and analyze all trends required under Section 23 09 55.

3.08 TREND Graphs

A. Trend graphs as specified in Section 23 09 55 shall generally be used during the Acceptance Phase to facilitate and document testing. Prepare controller and workstation software to display graphical format trends during the Acceptance Period. Trend graphs shall

demonstrate compliance with contract documents.

B. Each graph shall be clearly labeled with HVAC subsystem title, date, and times.

3.09 Warranty Phase BAS OPPOSITE SEASON Trending and Testing:

A. Trending: throughout the Warranty Phase, trend logs shall be maintained as required for the Acceptance Period. Contractor shall forward archive trend logs to the Commissioning Authority/ State for review upon Commissioning Authority/ State's request. Commissioning Authority/ The State will review these and notify contractor of any warranty work required.

B. Opposite Season Testing: Within 6 months of completion of the Acceptance Phase, Commissioning Authority/ The State shall schedule and conduct Opposite Season functional performance testing. Contractor shall participate in this testing and remedy any deficiencies identified.

3.10 SOFTWARE OPTIMIZATION ASSISTANCE

A. The Contractor shall provide the services of a BAS Technician as specified above at the project site to be at the disposal of the Commissioning Authority. The purpose of this requirement is to make changes, enhancements and additions to control unit and/or workstation software that have been identified by the Commissioning Authority during the construction and commissioning of the project and that are beyond the specified Contract requirements. The cost for this service shall be included with the bid. Requests for assistance shall be for contiguous or non-contiguous 8-hour days, unless otherwise mutually agreed upon by Contractor, Commissioning Authority, and State. The State's representative shall notify contractor 2 days in advance of each day of requested assistance.

B. The BAS Technician provided shall be thoroughly trained in the programming and operation of the controller and workstation software. If the BAS Technician provided cannot perform every software task requested by the Commissioning Authority in a timely fashion, contractor shall provide additional qualified personnel at the project site as requested by the Commissioning Authority, to meet the total specified requirement on-site.

3.11 BAS OPERATOR TRAINING and o&M manuals

A. Provide up to 4 complete sets of the approved Operations and Maintenance (O&M) Manuals (hard copy and one electronic copy) to be used for training.

B. Contractor shall submit a Training Plan for the scope of training for which they are responsible. Training Plan shall be forwarded to the Division 23 Contractor who will compile, organize, format, and forward to the Engineer for review.

C. On-Site Training: Provide services of controls contractor's qualified technical personnel for [five] 8-hour days to instruct State's personnel in operation and maintenance of BAS. Instruction shall be in classroom setting at the project site for appropriate portions of the training. Training may be in non-contiguous days at the request of the State. The State's representative shall notify contractor 1 week in advance of each day of requested training. The

Contractor's designated training personnel shall meet with the Engineer and State's representative for the purpose of discussing and fine-tuning the training agenda prior to the first training session. Training agenda shall generally be as follows:

1. Basic Operator Workstation (OWS) Training - For all potential users of the OWS:
   a. Brief walk-through of building, including identification of all controlled equipment and condensed demonstration of controller portable and built-in operator interface device display capabilities.
   b. Brief overview of the various parts of the O&M Manuals, including hardware and software programming and operating publications, catalog data, controls installation drawings, and DDC programming documentation.
   c. Demonstration of workstation login/logout procedures, password setup, and exception reporting.
   d. Demonstration of workstation menu penetration and broad overview of the various workstation features.
   e. Overview of systems installed.
   f. Present all site-specific point naming conventions and points lists, open protocol information, configuration databases, back-up sequences, upload/download procedures, and other information as necessary to maintain the integrity of the
   g. BAS. Overview of alarm features.
   h. Overview of trend features.
   i. Overview of workstation reports.
2. BAS Hardware Training - For Maintenance and Control Technicians
   a. Review of installed components and how to install/replace, maintain, commission, and diagnose them
3. BAS Technician Training
   a. Introduction to controller programming and overview of the programming application interface.
   b. General review of sequence of operation and control logic for the project site, including standalone and fail-safe modes of
   c. operation. Uploading/Downloading and backing up
   d. Network administration.
   e. Review of setpoint optimization and fine-tuning concepts.
4. Advanced Training: Advanced Training shall be provided for one (1) individual and be provided at an off-site training facility containing installations of the proposed system. Contractor shall pay training registration and materials fee and the State shall pay all employee expenses (travel, per diem, salary).
   a. Contractor shall provide the standard, advanced training offering on all Control Programming Applications.
   b. Contractor shall provide the standard, advanced training offering on Advanced Installation, Configuration, Maintenance, and Network Administration.

c. For Echelon-based systems, advanced training shall include a Lon systems integration course.

END OF SECTION 23 09 59

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Hot-water heating piping.
2. Chilled-water piping.
3. Condensate-drain piping.
4. Air-vent piping.
5. Safety-valve-inlet and -outlet piping.

1.3 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.

C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. Hot-Water Heating Piping: 125 psig at 200 deg F.
2. Chilled-Water Piping: 125 psig at 200 deg F.
3. Condensate-Drain Piping: 150 deg F.
4. Air-Vent Piping: 200 deg F.
5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.5 SUBMITTALS, GENERAL

A. General: Submit all action submittals and informational submittals required by this Section concurrently.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Plastic pipe and fittings with solvent cement.
2. RTRP and RTRF with adhesive.
3. Pressure-seal fittings.
4. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
5. Air control devices.
6. Chemical treatment.
7. Hydronic specialties.

B. LEED Submittal:

1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.

C. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1.7 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Qualification Data: For Installer.

1.8 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.9 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
2. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by the manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

1.10 EXTRA MATERIALS

A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.

B. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Wrought-Copper Fittings: ASME B16.22.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Anvil International, Inc.
b. S. P. Fittings; a division of Star Pipe Products.
c. Victaulic Company of America.

E. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 PLASTIC PIPE AND FITTINGS

A. CPVC Plastic Pipe: ASTM F 441/F 441M, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.

B. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.

C. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.

D. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.

a. Use CPVC solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

H. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Charlotte Pipe and Foundry Company.
   b. IPEX Inc.
   c. KBi.

3. CPVC and PVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.

B. Plastic-to-Metal Transition Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Charlotte Pipe and Foundry Company.
   b. IPEX Inc.
   c. KBi.
   d. NIBCO INC.

3. MSS SP-107, CPVC and PVC union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

2.6 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Hart Industries International, Inc.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.

3. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

3. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

3. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
4. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Calpico, Inc.
   b. Lochinvar Corporation.

3. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Perfection Corporation; a subsidiary of American Meter Company.
   b. Precision Plumbing Products, Inc.
   c. Sioux Chief Manufacturing Company, Inc.
   d. Victaulic Company of America.

3. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.7 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

C. Bronze, Calibrated-Orifice, Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Armstrong Pumps, Inc.
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
   c. Flow Design Inc.
   d. Gerand Engineering Co.
   e. Griswold Controls.
   f. Taco.

2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.

4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Armstrong Pumps, Inc.
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
   c. Flow Design Inc.
   d. Gerand Engineering Co.
   e. Griswold Controls.
   f. Taco.
   g. Tour & Andersson; available through Victaulic Company of America.

2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig.
11. Maximum Operating Temperature: 250 deg F.

E. Diaphragm-Operated, Pressure-Reducing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump; a division of ITT Industries.
   d. Conbraco Industries, Inc.
   e. Spence Engineering Company, Inc.
   f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.

4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: , removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Diaphragm-Operated Safety Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump; a division of ITT Industries.
   d. Conbraco Industries, Inc.
   e. Spence Engineering Company, Inc.
   f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: , removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Automatic Flow-Control Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Flow Design Inc.
   b. Griswold Controls.

2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Corrosion resistant, tamper proof, self cleaning, and removable.
4. Combination Assemblies: Include bonze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.

7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: 175 psig.
9. Maximum Operating Temperature: 200 deg F.

2.8 AIR CONTROL DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. Taco.

C. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

D. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/4.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 240 deg F.

E. Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig working pressure and 250 deg F maximum operating temperature.

3. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg F maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
4. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch- diameter gage glass, and slotted-metal glass guard.

F. Bladder-Type Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

G. Tangential-Type Air Separators:

1. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature.
2. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
3. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
4. Blowdown Connection: Threaded.
5. Size: Match system flow capacity.

H. In-Line Air Separators:

1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
2. Maximum Working Pressure: Up to 175 psig.
3. Maximum Operating Temperature: Up to 300 deg F.

I. Air Purgers:

1. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
2. Maximum Working Pressure: 150 psig.
3. Maximum Operating Temperature: 250 deg F.

2.9 CHEMICAL TREATMENT

A. Bypass Chemical Feeder: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.

1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

B. Ethylene and Propylene Glycol: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.

2.10 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

B. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

C. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig.

D. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

E. Spherical, Rubber, Flexible Connectors:

1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment.

4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

F. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

C. Chilled-water piping, aboveground, NPS 2 and smaller, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

D. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

E. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

F. Condensate-Drain Piping: Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

G. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

H. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.2 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

Q. Install unions in piping**,** NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

U. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

Y. Install HWAT Type Heat Trace on the exposed Condenser Water Supply and Return and the Make-up Water to the Closed Circuit Cooler. Heat Trace to be provided by the Mechanical Installer and powered up by the Electrical Installer.

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

E. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

F. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

G. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.

E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

F. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above the floor. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.

G. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.

   1. Install tank fittings that are shipped loose.
   2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

H. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.8 CHEMICAL TREATMENT

A. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the following water characteristics:

1. pH: 9.0 to 10.5
2. "P" Alkalinity: 100 to 500 ppm
3. Boron: 100 to 200 ppm
4. Chemical Oxygen Demand: Maximum 100 ppm. Modify this value if closed system contains glycol.
5. Corrosion Inhibitor:

    a. Sodium Nitrate: 1000 to 1500 ppm
    b. Molybdate: 200 to 300 ppm
    c. Chromate: 200 to 300 ppm
    d. Sodium Nitrate Plus Molybdate: 100 to 200 ppm each.
    e. Chromate Plus Molybdate: 50 to 100 ppm each.

6. Soluble Copper: Maximum 0.20 ppm.
7. Tolyiriazole Copper and Yellow Metal Corrosion Inhibitor: Minimum 10 ppm.
8. Total Suspended Solids: Maximum 10 ppm.
9. Ammonia: Maximum 20 ppm.
10. Free Caustic Alkalinity: Maximum 20 ppm.
11. Microbiological Limits:

    a. Total Aerobic Plate Count: Maximum 1000 organisms/ml.
    b. Total Anaerobic Plate Count: Maximum 100 organisms/ml.
    c. Nitrate Reducers: 100 organisms/ml.
    d. Sulfate Reducers: Maximum 0 organisms/ml.
    e. Iron Bacteria: Maximum 0 organisms/ml.

B. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

C. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

3.9 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.

2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13

SECTION 232113.13 - UNDERGROUND HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cased piping system.
2. Loose-fill insulation.

1.3 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing hydronic piping systems with the following minimum working-pressure ratings:

1. Condenser-Water Piping:150 psig at 150 deg F

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Conduit piping.
2. Loose-fill insulation.

1.5 INFORMATIONAL SUBMITTALS

A. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and at vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing hydronic piping.

B. Qualification Data: For qualified Installer.

C. Welding certificates.

D. Material Test Reports: For conduit piping.

E. Source quality-control reports.

F. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Pipe and Fitting Installers: Installers shall be certified by manufacturer of pipes and fittings as having been trained and qualified to join piping with manufacturer-recommended method.

B. Welding Qualifications: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31.9, "Building Services Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

PART 2 - PRODUCTS

2.1 CASED PIPING SYSTEM

A. Description: Factory-fabricated piping with carrier pipe, insulation, and casing.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Insul-Tek Piping Systems, Inc.
b. Perma-Pipe, Inc.
c. Rovanco Piping Systems, Inc.
d. Thermacor Process, L.P.
e. Thermal Pipe Systems.
f. Urecon Ltd.

B. Carrier Pipe: Fiberglass pipe and fittings.

C. Carrier Pipe Insulation:

1. Polyurethane Foam Pipe Insulation: Rigid, cellular, high-pressure injected between carrier pipe and jacket.

a. Comply with ASTM C 591; thermal conductivity (k-value) shall not exceed 0.14 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.

D. Casing: HDPE 0.034-nch- thick, spiral-wound, lock-seam galvanized steel

E. Casing accessories include the following:

1. Joint Kit: Half-shell, pourable or split insulation, casing sleeve, and shrink-wrap sleeve.
2. Expansion Blanket: Elastomeric foam, formed to fit over piping.
3. End Seals: Shrink wrap the casing material to seal watertight around casing and carrier pipe.

F. Manholes: Black steel with lifting eyes.

1. Finish: Spray-applied urethane, minimum 30 mils thick.
2. Access: 30-inch- diameter waterproof cover with gasket, ladder, and two 6-inch vents, one high and one low, extending above grade with rain caps.
3. Conduit Stub-Outs and Seals: Welded steel with drain and vent openings.
4. Sump: 12 inches in diameter,12 inches deep.
5. Floatation Anchor: Oversized bottom keyed into concrete base.

G. Source Quality Control: Factory test the carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates.

2.2 LOOSE-FILL INSULATION

A. Granular, Loose-Fill Insulation: Inorganic, nontoxic, nonflammable, sodium potassium aluminum silicate with calcium carbonate filler. Include chemical treatment that renders insulation hydrophobic.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Gilsulate International, Inc.

2. Thermal Conductivity (k-Value): 0.60 at 175 deg F and 0.65 at 300 deg F.
3. Application Temperature Range: 35 to 800 deg F.
4. Dry Density: 40 to 42 lb/cu. ft.
5. Strength: 12,000 lb/sq. ft.

PART 3 - EXECUTION

3.1 EARTHWORK

A. See Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATION

A. Condenser-Water Piping:

1. NPS 2-1/2 and larger shall be the following:

a. RP and RTRF with adhesive or flanged joints.
b. Loose-Fill Insulation: Granular or Powder.

2. Cased piping with polyurethane carrier-pipe insulation.

a. Piping Insulation Thickness: 2 inches.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Remove standing water in the bottom of trench.

C. Do not backfill piping trench until field quality-control testing has been completed and results approved.

D. Install piping at uniform grade of 0.2 percent. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points and elsewhere as required for system drainage. Install manual air vents at high points.

E. In conduits, install drain valves at low points and manual air vents at high points.

F. Install components with pressure rating equal to or greater than system operating pressure.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. See Section 230517 "Sleeves and Sleeve Seals for HVAC Piping" for sleeves and mechanical sleeve seals through exterior building walls.

J. Secure anchors with concrete thrust blocks. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

K. Install HWAT Type Heat Trace on the exposed Condenser Water Supply and Return and the Make-up Water to the Closed Circuit Cooler. Heat Trace to be provided by the Mechanical Installer and powered up by the Electrical Installer.

3.4 LOOSE-FILL INSULATION INSTALLATION

A. Do not disturb the bottom of trench; otherwise, compact and stabilize it to ensure proper support.

B. Remove standing water in the bottom of trench.

C. Bed the pipe on a minimum 6-inch layer of granular fill material with a minimum 6-inch clearance between the pipes.

D. Form insulation trench by excavation or by installing drywall side forms to establish required height and width of the insulation.

E. Support piping with proper pitch, separation, and clearance to backfill or side forms using temporary supporting devices that can be removed after back filling with insulation.

F. Place insulation and backfill after field quality-control testing has been completed and results approved.

G. Apply bitumastic coating to carbon-steel anchors and guides. Pour concrete thrust blocks and anchors. See Section 033000 "Cast-in-Place Concrete" for concrete and reinforcement.

H. Wrap piping at expansion loops and offsets with mineral-wool insulation of thickness appropriate for calculated expansion amount.

I. Pour loose-fill insulation to required dimension agitating insulation to eliminate voids around piping.

J. Remove temporary hangers and supports.

K. Cover loose-fill insulation with polyethylene sheet a minimum of 4 mils thick, and empty loose-fill insulation bags on top.

L. Manually backfill 6 inches of clean backfill. If mechanical compaction is required, manually backfill to 12 inches before using mechanical-compaction equipment.

3.5 JOINT CONSTRUCTION

A. See Section 330500 "Common Work Results for Utilities" for basic piping joint construction.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Ch. 35, "Pipe and Tubing," using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.

J. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

K. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

L. Conduit and Cased Piping Joints: Assemble sections and finish joints with pourable or split insulation and exterior jacket sleeve, and apply shrink-wrap seals.

3.6 IDENTIFICATION

A. Install continuous plastic underground warning tapes during back filling of trenches for underground hydronic piping. Locate tapes 6 to 8 inches below finished grade, directly over piping. See Section 312000 "Earth Moving" for warning-tape materials and devices and their installation.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Prepare hydronic piping for testing according to ASME B31.9 and as follows:

   a. Leave joints, including welds, uninsulated and exposed for examination during test.
   b. Fill system with water. Where there is risk of freezing, air or a safe, compatible liquid may be used.
   c. Use vents installed at high points to release trapped air while filling system.

2. Test hydronic piping as follows:

   a. Subject hydronic piping to hydrostatic test pressure that is not less than 1.5 times the design pressure.
   b. After hydrostatic test pressure has been applied for 10 minutes, examine joints for leakage. Remake leaking joints using new materials and repeat hydrostatic test until no leaks exist.

3. Test conduit as follows:

   a. Seal vents and drains and subject conduit to 15 psig for four hours with no loss of pressure. Repair leaks and retest as required.

E. Prepare test and inspection reports.

END OF SECTION 232113.13

SECTION 232113.33 - GROUND-LOOP HEAT-PUMP PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes piping for vertical direct-buried, ground-loop, heat-pump systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Pipe and fittings.
2. Joining method and equipment.
3. Propylene glycol solution.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Borehole backfilling and drilling operations reports.

C. Dimensioned site layout.

D. Startup performance results.

PART 2 - PRODUCTS

2.1 PIPES AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Centennial Plastics, LLC.
2. Chevron-Phillips Chemical Company; Performance Pipe Division.
3. Lamson Pipe Company.

B. HDPE Pipe: ASTM D 3035.

C. Molded PE Fittings: ASTM D 2683 or ASTM D 3261, ASTM F 1055 PE resin, socket, butt-fusion or electro-fusion type, made to match PE pipe dimensions and class.

D. U-Bend Assembly: Factory fabricated with embossed depth stamp every 24 inches from U-bend.

E. Ground-Loop, Heat-Pump Piping Minimum Working Pressure: 160 psig .

F. Ground-Loop, Heat-Pump Piping Operating Temperature: Between 23 and 104 deg F.

2.2 BOREHOLE BACKFILL

A. Seal Material: Bentonite clay with thermal conductivity greater than 1.07 Btu/h x sq. ft. x deg F according to ASTM D 5334.

B. Permeability: Not more than 1 nm/s according to ASTM D 5084

2.3 ANTIFREEZE SOLUTION

A. Propylene Glycol: Minimum 99 percent propylene glycol with corrosion inhibitors and environmental stabilizer additives to be mixed with water to protect piping circuit and connected equipment from physical damage caused by freezing or corrosion.

B. Quantity: Sufficient solution for initial system startup and for preventive maintenance for one year from date of Substantial Completion.

C. Dilution Water: Chloride content shall be less than 25 ppm, sulfate content less than 25 ppm, and hardness less than 100 ppm.

2.4 GEOTHERMAL MANIFOLD VAULT

A. Manufacturers:

1. Geo Vault
2. Pre-approved Equivalents

B. Complete turnkey underground vault and manifold construction of strong composite steel and concrete.
1. 12-gauge Stainless Steel floor.
2. Walls and ceiling constructed of steel sheeting and reinforcement rods.
3. Interior shall be continuously welded.

C. Epoxy painted walls and ceiling.

D. Link-sealed pipe penetrations.

E. Leak-proof HDPE manifold.

F. Service outlet and lighting.

G. Fresh air ventilation system.

H. Sump pump and pit.

I. Large service manway with layed entry.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, warning tape, and backfilling are specified in Section 312000 "Earth Moving."

3.2 VERTICAL PIPING INSTALLATION

A. Install HDPE piping in boreholes according to ASTM D 2774 or ASTM F 645.

1. Clean HDPE pipe and fittings and make heat-fusion joints according to ASTM D 2657. Minimize number of joints.

B. Purge, flush, and pressure test piping before backfilling boreholes.

C. Completely fill the borehole from bottom to top with backfill material.

D. Install the header piping 4 to 6 inches deep and install the horizontal piping from the header to the boreholes.

E. Extend the horizontal piping and connect to ground-loop heat-pump piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building ground-loop heat-pump piping systems are installed. Terminate piping with caps. Make connections to building ground-loop heat-pump piping systems when those systems are installed.

F. Backfill the horizontal piping and header trenches.

G. Fill the entire piping loop with water or antifreeze solution.

H. Maintain records of backfilling on-site.

I. Mark borehole locations, header pipes, and horizontal runs with metallic locator tape as specified in Section 230553 "Identification for HVAC Piping and Equipment."

J. Seal penetrations through building walls.

K. Wall sleeves are specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

L. Mechanical sleeve seals are specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

3.3 ANTIFREEZE SOLUTION FILL

A. Fill system with required quantity of propylene glycol and water to provide minus 10 deg F freezing temperature.

B. Test dilute solution using gas chromatography to verity concentration of propylene glycol, and forward report to Architect.

3.4 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

3.5 FIELD QUALITY CONTROL

A. Piping Tests: Fill piping 24 hours before testing and apply test pressure to stabilize piping. Use potable water only.

B. Hydrostatic Tests: Test at not less than 1-1/2 times the pipe working-pressure rating or 300 percent of system design pressure, whichever is more, allowing for static pressure of borehole depth.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 30 minutes. Slowly increase to next test pressure increment and hold for 30 minutes. After testing at maximum test pressure, reduce pressure to 30 psig. Hold for 90 minutes, and measure pressure at 30-minute intervals. Repair leaks and retest until no leaks exist.
2. Maintain a minimum pipe velocity of 24 in./s for a minimum of 15 minutes to remove all air.

C. Prepare test and inspection reports.

END OF SECTION 23 21 13.33

SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Separately coupled, base-mounted, end-suction centrifugal pumps.
2. Close-coupled, in-line centrifugal pumps.

1.3 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.4 SUBMITTALS, GENERAL

A. General: Submit all action submittals and informational submittals required by this Section concurrently.

1.5 ACTION SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Motor Data: Motor horsepower, electrical characteristics, and construction details

C. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

1. Wiring Diagrams: Power, signal, and control wiring

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.9 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mechanical Seals: One extra mechanical seal for each pump.
2. Filter Cartridges: Minimum one extra filter cartridge for each pump with filtered flush.

PART 2 - PRODUCTS

2.1 GENERAL PUMP REQUIREMENTS

A. Materials: Provide materials suitable for fluid, pressures, temperatures, and conditions for each application.

B. Performance: Minimum of design make throughout operating ranges, including capacity, head, NPSHR, and efficiency.

C. Configuration and Characteristics

1. Provide dynamically balanced pumps for all applications.
2. Provide tapped connections for pressure gauges at inlet and outlet, and vent and drain taps at high and low points.
3. Arrange for independent machinist to align each base mounted pump.

D. Motors:

1. Capable of running continuously without undue noise, heat, sparking, or overloading.
2. Extra quiet operating, EPAC “Plus” premium efficiencies for base-mounted pumps and custom premium efficiency for inline pumps.
3. Sized as non-overloading at 60 Hz with pump operating at any point on the impeller curve.
4. All three phase motors for use with variable speed drives shall be special application, inverter duty design of cast iron TEFC construction. Inverter duty design features shall include an inverter grade Class F insulation system meeting NEMA MG-1, Part 31, Class F thermostats, one per phase, premium efficiency design. Motors shall meet all other requirements of this document, the equipment manufacturer, and the adjustable speed drive manufacturer, and be rated for this service with the drive and voltage intended.

E. Pump Seals: Rated for continuous service for the fluid, temperature, conditions, and pressure of the required service. If conditions are not scheduled, verify in field before submitting Bid.

1. SiC/SiC/EPR Mechanical Seals: Silicon carbide rotating and stationary primary faces, bellows of EPT, EPDM, or other elastomer rated for the service, springs and other wetted seal parts of stainless steel.

F. Filters: Provide a filtered flush for seals.

1. Cartridge Filters For Closed Systems: Cartridge type seal flush filters, factory installed and capable of 98 percent removal of particles 25 microns and larger. Includes in-line sight flow indicator and isolation valves as required to facilitate filter changing without system shutdown.

2. Quantity: Provide minimum 3 filter cartridges for each system; minimum 1 for temporary use during system startup and commissioning (change to new filter as required during temporary service before final completion), change to new cartridge immediately

following acceptance of Substantial Completion, and provide one spare filter cartridge turned over to Owner for each filtered flush system.

2.2 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include manufacturers specified.

1. Armstrong Pumps Inc.
2. ITT Corporation; Bell & Gossett.
3. PACO Pumps.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump designed for base mounting, with pump and motor shafts horizontal. Rate pump for 125-psig minimum working pressure and a continuous water temperature of 225 deg F.

C. Pump Construction:

1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections. Provide integral mount on volute to support the casing, and attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
3. Pump Shaft: Steel, with copper-alloy shaft sleeve, or stainless steel.
4. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.

D. Shaft Coupling: Molded rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor. Include EPDM coupling sleeve for variable-speed applications.

E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

F. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

2.3 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Armstrong Pumps Inc.

2. Grundfos Pumps Corporation.
3. ITT Corporation; Bell & Gossett.
4. TACO Incorporated.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump; designed for installation with pump and motor shafts mounted horizontally or vertically.

C. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, replaceable bronze wear rings, and threaded connections.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings: Permanently lubricated ball bearings.

D. Motor: Rigidly mounted to pump casing.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.4 PUMP SPECIALTY FITTINGS

A. Suction Diffuser: Angle pattern, 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory-fabricated support.

B. Triple-Duty Valve: Angle or straight pattern, 175-psig pressure rating, cast-iron body, pump-discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features. Brass gage ports with integral check valve, and orifice for flow measurement.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine conditions under which pumps are to be installed and notify Architect in writing of any conditions detrimental to proper and timely installation. Correct unsatisfactory conditions as required, and do not proceed with installation until unsatisfactory conditions have been corrected in an acceptable manner.

1. Insure equipment foundations and anchor-bolt locations are in compliance with installation tolerances and other conditions affecting performance of work and service access.

2. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

3. Beginning installation will indicate conditions are acceptable to Contractor to ensure proper and timely installation and to ensure requirements for applicable warranty or guarantee can be satisfied.

B. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 CONCRETE BASES

A. Install concrete bases of proper dimensions as specified for pumps and controllers. Refer to Division 23 Section "Common Work Results for HVAC."

B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.3 PUMP INSTALLATION

A. Install in accordance with manufacturer's specific recommendations and in accordance with all related sections of technical specifications. Obtain manufacturer's instructions and follow them, using the instructions written below as a minimum standard for comparison.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Installation for all base mounted pumps shall be as follows in the sequence written:

1. Install on a concrete base as outlined in Division 23 Section “Common Work Results for HVAC”.

   a. Set adjustable internally threaded concrete inserts at appropriate bolt-down locations before pouring equipment bases.
   b. Be responsible for accurate size of base and exact location of mounting bolts.
   c. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.

2. Fasten all pump bases to concrete bases with foundation bolts.

   a. Insure that the pump suction and discharge flanges are orthogonal to the structural base of the pump without shimming. Securely tighten all pump impeller housing bolts to the pump base, and use the discharge flange surface for leveling and the pump base rails for lateral alignment of the pump to the system. Align the motor to the pump after the pump base is properly grouted.

b. Properly level each pump base. Use metal wedges and/or shims set on both sides of every bolt. Make a minimum gap of three times the grout aggregate size or 1/2-inch, whichever is greater.
c. Securely tighten all pump base bolts.
d. Remove projecting parts of wedges and shims.

3. Properly grout the complete base.

a. Fill all pump bases with grout conforming to CRD-C-621-80 "Corps of Engineers Specification for Non-Shrink Grout", and as detailed in Division 03.
b. Fill base through grouting holes provided in baseplate.
c. After grout has hardened for a minimum of seven (7) days, re-tighten all pump foundation bolts and only then align pumps.

4. Align pumps.

a. Engage an independent machinist to align each pump.
b. Submit machinist's name, business address, and qualifications.
c. Do not pipe or start up any pump until after alignment is complete and correct.
d. Align all pumps by moving the motor with respect to the fixed impeller housing.
e. If the impeller housing flanges are substantially out of level and/or alignment with respect to the system, the machinist shall bring them into alignment using a minimum of shims and an appropriate thin set grout before aligning the motor.
f. Motor shaft to impeller shaft alignment tolerances shall be the lesser of:

1) Manufacturer’s printed alignment tolerances.
2) 0.004-inch TIR radial and 0.004-inch TIR angular at 3-inch radius.

g. After pumps are aligned, install dowels to prevent shifting and properly re-install coupling and guard.
h. Within two (2) business days of alignment, the machinist shall submit a written report to the Contractor and Architect guaranteeing that alignment is complete and stating the alignment tolerances required and obtained.
i. Contractor is responsible for trouble resulting from poor pump alignment.

5. Connect the pipe system to the pumps:

a. Install inlet suction diffusers for all end suction pumps with support legs adjusted to prevent any strain on the pump inlet.
b. Install pipeline flexible connectors at each suction (diffuser) and discharge port of each pump. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
c. Pipe as required by the detail pump connection drawings, including all valves, fittings, gauges, and controls.

6. Three (3) operating months later, have the machinist recheck all alignments, recording data, correcting any changes, and reporting in writing to the Contractor and Architect all data and offering an interpretation of the cause and significance of the changes.
7. Submit letter attesting to completion of alignment.

D. Adjust GPM of each pump to capacity called for during balancing.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install triple-duty valve on discharge side of pumps.

F. Install suction diffuser and shutoff valve on suction side of pumps.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

H. Install pressure gages on pumps as specified.

I. Install electrical connections for power, controls, and devices.

J. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

K. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.

7. Open discharge valve slowly.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 21 23

SECTION 23 29 00 – VARIABLE FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes separately enclosed, pre-assembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. CPT: Control power transformer.

C. EMI: Electromagnetic interference.

D. IGBT: Insulated-gate bipolar transistor.

E. LAN: Local area network.

F. LED: Light-emitting diode.

G. MCP: Motor-circuit protector.

H. NC: Normally closed.

I. NO: Normally open.

J. OCPD: Overcurrent protective device.

K. PCC: Point of common coupling.

L. PID: Control action, proportional plus integral plus derivative.

M. PWM: Pulse-width modulated.

N. RFI: Radio-frequency interference.

O. TDD: Total demand (harmonic current) distortion.

P. THD(V): Total harmonic voltage demand.

Q. VFC: Variable-frequency motor controller.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: VFCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS, GENERAL

A. General: Submit all action submittals and informational submittals required by this Section concurrently.

1.6 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFC indicated. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, and furnished specialties and accessories.

B. Shop Drawings: For each VFC indicated. Include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.

1. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.
b. Factory-installed devices.
c. Enclosure types and details.
d. Nameplate legends.
e. Short-circuit current (withstand) rating of enclosed unit.
f. Features, characteristics, ratings, and factory settings of each VFC and installed devices.
g. Specified modifications.

2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring.

1.7 INFORMATIONAL SUBMITTALS

A. Harmonic Analysis Study and Report: Comply with IEEE 399 and NETA Acceptance Testing Specification; identify the effects of nonlinear loads and their associated harmonic contributions on the voltages and currents throughout the electrical system. Analyze operating scenarios, including recommendations for VFC input filtering to limit TDD and THD(V) at each VFC to specified levels.

B. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFCs. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

C. Qualification Data: For qualified testing agency.

D. Seismic Qualification Certificates: For VFCs, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

E. Product Certificates: For each VFC, from manufacturer.

F. Source quality-control reports.

1.8 CLOSEOUT SUBMITTALS

A. Field quality-control reports.

B. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.
2. Manufacturer's written instructions for setting field-adjustable overload relays.
3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

C. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.

D. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.9 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

D. IEEE Compliance: Fabricate and test VFC according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

1.10 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Furnish all equipment in cartons and within shrink-wrapped plastic to Project in ample time for installation. Properly tag and identify equipment furnished.

B. Storage and Protection: Store all equipment in secure location with dry and non-condensing environment.

1.11 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than 14 deg F and not exceeding 104 deg F.
2. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F
3. Humidity: Less than 95 percent (noncondensing).
4. Altitude: Not exceeding 3300 feet.

B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Construction Manager and Owner no fewer than seven days in advance of proposed interruption of electrical systems.
2. Indicate method of providing temporary electrical service.
3. Do not proceed with interruption of electrical systems without Construction Manager's and Owner's written permission.

4. Comply with NFPA 70E.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.12 COORDINATION

A. Coordinate features of motors, load characteristics, installed units, and accessory devices to be compatible with the following:

1. Torque, speed, and horsepower requirements of the load.
2. Ratings and characteristics of supply circuit and required control sequence.
3. Ambient and environmental conditions of installation location.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.13 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.14 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three (3) of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two (2) of each size and type.
3. Indicating Lights: Two (2) of each type and color installed.
4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three (3) spares for each size and type of magnetic contactor installed.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, the following:

1. ABB.
2. Baldor Electric Company.
3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
4. Rockwell Automation, Inc.; Allen-Bradley Brand.
5. Square D; a brand of Schneider Electric.
6. Yaskawa Electric America, Inc; Drives Division.

B. General Requirements for VFCs: Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.

C. Application: variable torque.

D. VFC Description: Variable-frequency power converter (rectifier, dc bus, and IGBT, PWM inverter) factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

E. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

F. Output Rating: Three-phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

G. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 15 percent of VFC input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 3 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
4. Minimum Efficiency: 97 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.

6. Minimum Short-Circuit Current (Withstand) Rating: 42 kA.
7. Ambient Temperature Rating: Not less than 14 deg F and not exceeding 104 deg F.
8. Ambient Storage Temperature Rating: Not less than minus 4 deg F and not exceeding 140 deg F
9. Humidity Rating: Less than 95 percent (noncondensing).
10. Altitude Rating: Not exceeding 3300 feet.
11. Vibration Withstand: Comply with IEC 60068-2-6.
12. Overload Capability: 1.5 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
13. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
14. Speed Regulation: Plus or minus 5 percent.
15. Output Carrier Frequency: Selectable; 0.5 to 12 minimum kHz.
16. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

H. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.

I. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.

1. Signal: Electrical.

J. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 999.9 seconds.
4. Deceleration: 0.1 to 999.9 seconds.
5. Current Limit: 30 to minimum of 150 percent of maximum rating.

K. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
3. Under- and overvoltage trips.
4. Inverter overcurrent trips.
5. VFC and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved.
6. Critical frequency rejection, with three selectable, adjustable deadbands.
7. Instantaneous line-to-line and line-to-ground overcurrent trips.
8. Loss-of-phase protection.
9. Reverse-phase protection.
10. Short-circuit protection.
11. Motor overtemperature fault.

L. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

M. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

P. Integral Input Disconnecting Means and OCPD: NEMA AB 1, instantaneous-trip circuit breaker with pad-lockable, door-mounted handle mechanism.

1. Disconnect Rating: Not less than 115 percent of VFC input current rating.
2. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
3. Auxiliary Contacts: NO/NC, arranged to activate before switch blades open.
4. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.
5. NC and NO alarm contact that operates only when circuit breaker has tripped.

2.2 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators displaying the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.

a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.

C. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

D. Indicating Devices: Digital display mounted flush in VFC door and connected to display VFC parameters including, but not limited to:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).

E. Control Signal Interfaces:

1. Electric Input Signal Interface:

a. A minimum of 2 programmable analog inputs: 0- to 10-V dc and 4- to 20-mA dc.
b. A minimum of six multifunction programmable digital inputs.

2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:

a. 0- to 10-V dc.
b. 4- to 20-mA dc.
c. Potentiometer using up/down digital inputs.
d. Fixed frequencies using digital inputs.

3. Output Signal Interface: A minimum of 2 programmable analog output signal(s) (0- to 10-V dc or 4- to 20-mA dc), which can be configured for any of the following:

a. Output frequency (Hz).
b. Output current (load).
c. DC-link voltage (V dc).
d. Motor torque (percent).
e. Motor speed (rpm).
f. Set point frequency (Hz).

4. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

   a. Motor running.
   b. Set point speed reached.
   c. Fault and warning indication (overtemperature or overcurrent).
   d. PID high- or low-speed limits reached.

F. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display VFC status and alarmsand energy usage. Allows VFC to be used with an external system within a multidrop LAN configuration; settings retained within VFC's nonvolatile memory.

1. Network Communications Ports: Ethernet and RS-422/485.
2. Embedded BAS Protocols for Network Communications: ASHRAE 135 BACnet and/or Echelon LonWorks; protocols accessible via the communications ports.

2.3 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: Provide 3 percent AC line reactor between the line and the drive.

B. Output Filtering: For lead lengths over 50 feet, provide 5 percent load reactor between the drive and the load.

C. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.

2.4 BYPASS SYSTEMS

A. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.

B. Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic control system feedback.

C. Bypass Controller: Two-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.

1. Bypass Contactor: Load-break, NEMA-rated contactor.
2. Output Isolating Contactor: Non-load-break, NEMA-rated contactor.
3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized,

while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.

D. Bypass Contactor Configuration: Reduced-voltage (autotransformer) type.

1. NORMAL/BYPASS selector switch.
2. HAND/OFF/AUTO selector switch.
3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFC while the motor is running in the bypass mode.
4. Contactor Coils: Pressure-encapsulated type.

   a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
   b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.

5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.

   a. CPT Spare Capacity: 100 VA.

6. Overload Relays: NEMA ICS 2.

   a. Solid-State Overload Relays:

      1) Switch or dial selectable for motor-running overload protection.
      2) Sensors in each phase.
      3) Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
      4) Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
      5) Analog communication module.

   b. NO isolated overload alarm contact.
   c. External overload reset push button.

2.5 OPTIONAL FEATURES

A. Multiple-Motor Capability: VFC suitable for variable-speed service to multiple motors. Overload protection shuts down VFC and motors served by it, and generates fault indications, when overload protection activates.

1. Configure to allow two or more motors to operate simultaneously at the same speed; separate overload relay for each controlled motor.

2. Configure to allow two motors to operate separately; operator selectable via local or remote switch or contact closures; single overload relay for both motors; separate output magnetic contactors for each motor.
3. Configure to allow two motors to operate simultaneously and in a lead/lag mode, with one motor operated at variable speed via the power converter and the other at constant speed via the bypass controller; separate overload relay for each controlled motor.

B. Damper control circuit with end of travel feedback capability.

C. Sleep Function: Senses a minimal deviation of a feedback signal and stops the motor. On an increase in speed-command signal deviation, VFC resumes normal operation.

D. Motor Preheat Function: Preheats motor when idle to prevent moisture accumulation in the motor.

E. Firefighter's Override (Smoke Purge) Input: On a remote contact closure from the firefighter's control station, this password-protected input:

1. Overrides all other local and external inputs (analog/digital, serial communication, and all keypad commands).
2. Forces VFC to operate motor, without any other run or speed command, at a field-adjustable, preset speed.
3. Forces VFC to transfer to Bypass Mode and operate motor at full speed.
4. Causes display of Override Mode on the VFC display.
5. Reset VFC to normal operation on removal of override signal automatically.

F. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

G. Remote digital operator kit.

H. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

2.6 ENCLOSURES

A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.

1. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.7 ACCESSORIES

A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty type.

a. Push Buttons: Recessed types; maintained or momentary as applicable.
b. Pilot Lights: LED types; colors as required; push to test.
c. Selector Switches: Rotary type.

B. Reversible NC/NO bypass contactor auxiliary contact(s).

C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

E. Supplemental Digital Meters:

1. Elapsed-time meter.
2. Kilowatt meter.
3. Kilowatt-hour meter.

F. Cooling Fan and Exhaust System: As required for NEMA 250, Type 12; UL 508 component recognized: Supply fan, with composite or stainless steel intake and exhaust grills and filters; 120 -V ac; obtained from integral CPT.

G. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

2.8 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.

1. Test each VFC while connected to a motor that is comparable to that for which the VFC is rated.
2. Verification of Performance: Rate VFCs according to operation of functions and features specified.

B. VFCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.

B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 INSTALLATION

A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Wall-Mounting Controllers: Install VFCs on walls with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Division 23 Section "Identification for HVAC Piping and Equipment."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each VFC with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic control devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic control devices that have no safety functions when switches are in manual-control position.
2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.

4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect and Construction Manager before starting the motor(s).
5. Test each motor for proper phase rotation.

6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each VFC 11 months after date of Substantial Completion.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. VFCs will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

A. Provide services of a manufacturer’s factory –authorized service representative to inspect complete installation, start and adjust each drive, and train the Owner in drive operation, maintenance, and adjustment.

B. Coordinate services of adjustable speed drive factory –authorized service representative, TAB Agency, and Controls Technicians to insure proper coordinated operation and system control.

C. Complete additional installation and startup checks according to manufacturer's written instructions.

D. Submit letter from manufacturer’s factory –authorized service representative attesting to the satisfactory completion of installation and startup, with attached start-up / calibration forms for each drive with all appropriate adjustment settings itemized.

3.7 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Fully adjust each adjustable speed drive including maximum and minimum speeds, rates of speed change, calibration, testing, and as otherwise required to meet the operational intent and all control sequences.

D. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect and Construction Manager before increasing settings.

E. Set the taps on reduced-voltage autotransformer controllers.

F. Set field-adjustable circuit-breaker trip ranges as specified in Division 26.

3.8 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

1. Submit letter from factory-authorized service representative attesting to the satisfactory completion of Owner’s training, signed by Owner’s representatives.

END OF SECTION 26 29 23

SECTION 23 31 00 - AIR DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals and informational submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.

10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Mechanical Equipment.
   d. Fire Alarm Devices.
   e. Speakers.
   f. Sprinklers.
   g. Access panels.
   h. Perimeter moldings.

B. Welding certificates.

1.6 CLOSEOUT SUBMITTALS

A. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Lindab Inc.
   b. McGill AirFlow LLC.
   c. SEMCO Incorporated.
   d. Sheet Metal Connectors, Inc.

e. Spiral Manufacturing Co., Inc.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corporation; Insulation Group.
b. Johns Manville.
c. Knauf Insulation.
d. Owens Corning.

2. Maximum Thermal Conductivity:

a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Aeroflex USA Inc.
    b. Armacell LLC.
    c. Rubatex International, LLC

2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

    a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick stainless steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

    a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
11. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
12. Service: Indoor or outdoor.
13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round and flat-oval ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.3 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

   a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, selected by Architect from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).

2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.

5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units and Terminal Units:

a. Pressure Class: Positive 2-inch wg.

b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 3.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units and Terminal Units:

a. Pressure Class: Positive or negative 1-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 3-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 3.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 3-inch wg.
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.

c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

3. Ducts Connected to Fans Exhausting Laboratory and Process (ASHRAE 62.1, Class 3 and 4) Air:

a. Type 304, stainless-steel sheet.

1) Exposed to View: No. 3 finish.
2) Concealed: No. 2B finish.

b. PVC-coated, galvanized sheet steel with thicker coating on duct interior.
c. Pressure Class: Positive or negative 3-inch wg.
d. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
e. SMACNA Leakage Class: 3.

4. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. PVC-Coated Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Match duct material.

3. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Match duct material.

F. Liner:

1. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick.
2. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.
3. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.

G. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity 1000 fpm or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Welded.

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

   a. Velocity 1000 fpm or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm: Conical tap.
   c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 00

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Manual volume dampers.
2. Control dampers.
3. Fire dampers.
4. Flange connectors.
5. Turning vanes.
6. Remote damper operators.
7. Duct-mounted access doors.
8. Flexible connectors.
9. Flexible ducts.
10. Duct accessory hardware.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals and informational submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.

b. Manual volume damper installations.

c. Control damper installations.
d. Fire-damper installations including sleeves; and duct-mounted access doors and remote damper operators.
e. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Exposed-Surface Finish: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.

D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Air Balance Inc.; a division of Mestek, Inc.
   b. American Warming and Ventilating; a division of Mestek, Inc.
   c. Flexmaster U.S.A., Inc.
   d. McGill AirFlow LLC.
   e. Nailor Industries Inc.
   f. Ruskin Company.
   g. Trox USA Inc.
   h. Vent Products Company, Inc.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:

   a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized-steel, 0.064 inch thick.

6. Blade Axles: Galvanized steel.
7. Bearings:

    a. Stainless-steel sleeve.
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Air Balance Inc.; a division of Mestek, Inc.
    b. American Warming and Ventilating; a division of Mestek, Inc.
    c. McGill AirFlow LLC.
    d. Nailor Industries Inc.
    e. Ruskin Company.
    f. Trox USA Inc.
    g. Vent Products Company, Inc.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
    e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.

6. Blade Axles: Stainless steel.
7. Bearings:

    a. Stainless-steel sleeve.
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Aluminum.

C. Low-Leakage, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Air Balance Inc.; a division of Mestek, Inc.
b. American Warming and Ventilating; a division of Mestek, Inc.
c. McGill AirFlow LLC.
d. Nailor Industries Inc.
e. Ruskin Company.
f. Trox USA Inc.
g. Vent Products Company, Inc.

2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
3. Suitable for horizontal or vertical applications.

4. Frames:

a. Angle shaped.
b. Galvanized-steel channels, 0.064 inch thick.
c. Mitered and welded corners.
d. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Galvanized, roll-formed steel, 0.064 inch thick.

6. Blade Axles: Stainless steel.

7. Bearings:

a. Stainless-steel sleeve.
b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Blade Seals: Vinyl.
9. Jamb Seals: Cambered stainless steel.
10. Tie Bars and Brackets: Galvanized steel.
11. Accessories:

a. Include locking device to hold single-blade dampers in a fixed position without vibration.

D. Low-Leakage, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Air Balance Inc.; a division of Mestek, Inc.

b. American Warming and Ventilating; a division of Mestek, Inc.
c. McGill AirFlow LLC.
d. Nailor Industries Inc.
e. Ruskin Company.
f. Trox USA Inc.
g. Vent Products Company, Inc.

2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
3. Suitable for horizontal or vertical applications.
4. Frames: Angle-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
d. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.

6. Blade Axles: Stainless steel.
7. Bearings:

a. Stainless-steel sleeve.
b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Blade Seals: Vinyl.
9. Jamb Seals: Cambered stainless steel.
10. Tie Bars and Brackets: Galvanized steel.
11. Accessories:

a. Include locking device to hold single-blade dampers in a fixed position without vibration.

E. Jackshaft:

1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.3 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Lloyd Industries, Inc.
6. McGill AirFlow LLC.
7. Metal Form Manufacturing, Inc.
8. Nailor Industries Inc.
9. NCA Manufacturing, Inc.
10. Ruskin Company.
11. Vent Products Company, Inc.
12. Young Regulator Company.

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Angle shaped.
2. Galvanized-steel channels, 0.064 inch thick.
3. Mitered and welded corners.

D. Blades:

1. Multiple blade with maximum blade width of 8 inches.
2. Parallel- and opposed-blade design.
3. Galvanized steel.
4. 0.064 inch thick.
5. Blade Edging: Closed-cell neoprene edging.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: 1/2-inch- diameter; stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:

1. Stainless-steel sleeve.
2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.4 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Nailor Industries Inc.
6. NCA Manufacturing, Inc.
7. Prefco; Perfect Air Control, Inc.
8. Ruskin Company.
9. Vent Products Company, Inc.
10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

K. Heat-Responsive Device: Electric resettable link and switch package, factory installed, 165 deg F rated.

2.5 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.6 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

E. Vane Construction: Single wall for ducts up to 30 inches wide and double wall for larger dimensions.

2.7 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Warming and Ventilating; a division of Mestek, Inc.

2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Flexmaster U.S.A., Inc.
5. Greenheck Fan Corporation.
6. McGill AirFlow LLC.
7. Nailor Industries Inc.
8. Ventfabrics, Inc.
9. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.8 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.

D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.9 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.10 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.

C. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 175 deg F.
4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1-2004.

D. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 210 deg F.
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.

E. Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 210 deg F.
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.

F. Insulated, Flexible Duct: UL 181, Class 0, interlocking spiral of aluminum foil; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 8-inch wg positive or negative.
2. Maximum Air Velocity: 5000 fpm.
3. Temperature Range: Minus 20 to plus 250 deg F.
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004].

G. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
2. Non-Clamp Connectors: Liquid adhesive plus tape.

2.11 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where air terminal units are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.

2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot spacing.
8. Upstream and downstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.
11. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

O. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with liquid adhesive plus tape.

Q. Install duct test holes where required for testing and balancing purposes.

R. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 33 00

SECTION 23 34 00 - HVAC FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Utility set fans.
2. Tubeaxial fans.
3. Vaneaxial fans.
4. Mixed-flow fans.
5. In-Line Centrifugal Fans.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.

B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS, GENERAL

A. General: Submit all action submittals and informational submittals required by this Section concurrently.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

1.7 CLOSEOUT SUBMITTALS

A. Field quality-control reports.

B. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for commercial kitchen exhaust shall also comply with UL 762.

1.9 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set(s) for each belt-driven unit.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

2.2 IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Acme Engineering & Manufacturing Corporation.
2. Breidert Air Products.
3. Carnes Company.
4. Greenheck Fan Corporation.
5. Hartzell Fan Incorporated.
6. Loren Cook Company.
7. PennBarry.

B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

F. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
3. Companion Flanges: For inlet and outlet duct connections.
4. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
5. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
6. Vibration Isolators:

a. Type: Elastomeric hangers.
b. Static Deflection: 1 inch .

7. Spark Arrestance Class: A B C.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Electrical Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

B. Enclosure Type: Totally enclosed, fan cooled.

2.4 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 INSTALLATION

A. Install power ventilators level and plumb.

B. Install floor-mounted units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Install floor-mounted units on concrete bases designed to withstand, without damage to equipment, the seismic force required by code. Concrete, reinforcement, and formwork requirements are specified in Division 03.

D. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Division 07 Section "Roof Accessories" for installation of roof curbs.

E. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

F. Install units with clearances for service and maintenance.

G. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.3 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.

5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION 23 34 00

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.

2. Linear Slot Diffusers.

B. Related Sections:

1. Division 23 Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

C. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Price Industries or comparable product by one of the following:

   a. Hart & Cooley Inc.
   b. METALAIRE, Inc.
   c. Kruger.
   d. Titus.
   e. Tuttle & Bailey.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel.
4. Finish: Baked enamel, white.
5. Face Size: 24 by 24 inches.
6. Mounting: T-bar.
7. Pattern: Adjustable.
8. Dampers: Combination damper and grid.
9. Accessories:

   a. Equalizing grid.
   b. Sectorizing baffles.
   c. Operating rod extension, as required.

2.2 REGISTERS AND GRILLES

A. Adjustable Bar Register :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Price Industries or comparable product by one of the following:

   a. Hart & Cooley Inc.
   b. METALAIRE, Inc.
   c. Nailor Industries Inc.
   d. Krueger.
   e. Titus.
   f. Tuttle & Bailey.

2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Horizontal spaced 3/4 inch 1/2 inch apart.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.

7. Frame: 1-1/4 inches wide.
8. Mounting: Lay in.
9. Damper Type: Adjustable opposed blade.
10. Face Size: 24 by 24 inches.

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

2.4 CEILING LINEAR SLOT OUTLETS

A. Linear Slot Diffuser:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Price Industries Model SDS100 or comparable product by one of the following:

   a. Anemostat Products; a Mestek company.
   b. Carnes.
   c. Hart & Cooley Inc.
   d. Krueger
   e. Metalaire, Inc.
   f. Nailor Industries Inc.
   g. Titus.
   h. Tuttle & Bailey.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material - Shell: Steel, insulated.
4. Material - Pattern Controller and Tees: Aluminum.
5. Finish - Face and Shell: White Powder Coat
6. Finish - Pattern Controller: Baked enamel, black.
7. Finish - Tees: Baked enamel, white.
8. Slot Width: 3/4 inch.
9. Number of Slots: Two.
10. Length: 24 inches.
11. Accessories: T-bar Lay-in and SDB Linear Slot Plenum.
12. End Condition: Type Z.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Beginning construction constitutes Contractor's acceptance of substrates and conditions.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13

SECTION 23 51 00 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Listed double-wall vents and chimneys.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals and informational submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Special gas vents.
2. Guy wires and connectors.

B. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, hangers and seismic restraints, and location and size of each field connection.
2. For installed products indicated to comply with design loads, include calculations required for selecting seismic restraints and structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITALS

A. Welding certificates.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Breeching, Chimneys, and Stacks: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of anchorage devices on which the certification is based and their installation requirements.

1.6 CLOSEOUT SUBMITTALS

A. Warranty: Special warranty specified in this Section.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain listed system components through one source from a single manufacturer.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," for hangers and supports and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents, breechings, and stacks.

C. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, structural failures caused by expansion and contraction.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LISTED SPECIAL GAS VENTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Heat-Fab, Inc.
2. Metal-Fab, Inc.
3. Selkirk Inc.; Selkirk Metalbestos and Air Mate.
4. Z-Flex; Flexmaster Canada Limited.

B. Description: Double-wall metal vents tested according to UL 1738 and rated for 480 deg F continuously, with positive or negative flue pressure complying with NFPA 211.

C. Construction: Inner shell and outer jacket separated by at least a 1/2-inch airspace.

D. Inner Shell: ASTM A 959, Type 29-4C stainless steel.

E. Outer Jacket: 300 series Stainless steel.

F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies roof, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

1. Termination: Exit cone with drain section incorporated into riser.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 APPLICATION

A. Listed Special Gas Vent: Condensing gas appliances.

3.3 INSTALLATION OF LISTED VENTS AND CHIMNEYS

A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

B. Seal between sections of positive-pressure vents and grease exhaust ducts according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

D. Slope breechings down in direction of appliance, with condensate drain connection at lowest point, and condensate drain ring fitting at base of riser, all piped to condensate neutralizing station through 24 inch deep trap or F&T, then piped to nearest floor drain.

E. Lap joints in direction of flow.

F. Connect base section to foundation using anchor lugs of size and number recommended by manufacturer.

G. Join sections with acid-resistant joint cement to provide continuous joint and smooth interior finish.

H. Erect stacks plumb to finished tolerance of no more than 1 inch out of plumb from top to bottom.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.

C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION 23 51 00

SECTION 23 52 16 - CONDENSING BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged, factory-fabricated and -assembled, gas-fired, fire-tube condensing boilers, trim, and accessories for generating hot water.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals and informational submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Source quality-control test reports.

B. Warranty: Special warranty specified in this Section.

C. Other Informational Submittals:

1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.

1.6 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

C. Warranty: Executed special warranty specified in this Section.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers."

E. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

F. I=B=R Performance Compliance: Condensing boilers must be rated in accordance with applicable federal testing methods and verified by AHRI as capable of achieving the energy efficiency and performance ratings as tested within prescribed tolerances.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Fire-Tube Condensing Boilers:

a. Leakage and Materials: 10 years from date of Substantial Completion.

b. Heat Exchanger Damaged by Thermal Stress and Corrosion: Non-prorated for five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. RBI
2. AERCO International.
3. Lochinvar Corporation.
4. Viessmann Manufacturing Co. (US) Inc.

2.2 FIRE-TUBE CONDENSING BOILERS (3 MBTU BOILERS)

A. Description: Natural gas fired, fully condensing, fire tube design boiler. Power burner with full modulation and discharge into a positive pressure vent. Boiler sizing information may be found on the Boiler Schedule on the drawings. Boiler efficiency shall increase with decreasing load (output), while maintaining setpoint. Factory-fabricated, -assembled, and -tested, fire-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls.

B. Heat Exchanger: Constructed of 316L stainless steel fire tubes and tubesheets, with a one-pass combustion gas flow design. The fire tubes minimum 5/8” OD, with no less than 0.065” wall thickness, proportionally thicker for larger tubes. Fire tubes shall be configured for enhanced turbulence and resultant heat transfer efficiency. The upper and lower stainless steel tubesheet to be no less than 0.375” thick. The pressure vessel/heat exchanger to be welded construction, ASME stamped for a working pressure not less than 160 psig. Access to the tubesheets and heat exchanger shall be available by burner and exhaust manifold removal. Minimum access opening to be no less than 10-inch diameter.

C. Pressure Vessel: The boiler water pressure drop to not exceed 5.5 psig at 258 gpm. 4-inch flanged 150-pound, boiler water connections ANSI rated. The pressure vessel to be constructed of SA53 carbon steel, with a 0.25-inch thick wall and 0.50-inch thick upper head. Inspection openings in the pressure vessel are be in accordance with ASME Section IV pressure vessel code. Designed so that the thermal efficiency increases as the boiler firing rate decreases.

D. Modulating Air/Fuel Valve and Burner: The boiler burner shall be capable of a minimum 15-to-1 turndown ratio of the firing rate without loss of combustion efficiency. The burner is to produce less than 30 ppm of NOx corrected to 3 percent excess oxygen. The unit to be certified by the South Coast Air Quality Management District (SCAQMD) as compliant with Rule 1146.1 for boilers and water heaters greater than 2 MBTU’s and less than 5 MBTUs. The burner shall be metal-fiber mesh covering a stainless steel body with spark ignition and flame

rectification. All burner material exposed to the combustion zone shall be of stainless steel construction. There shall be no moving parts within the burner itself. A modulating air/fuel valve shall meter the air and fuel input. The modulating motor must be linked to both the gas valve body and air valve body with a single linkage. The linkage shall not require any field adjustment. A variable frequency drive (VFD), controlled cast aluminum pre-mix blower shall be used to ensure the optimum mixing of air and fuel between the air/fuel valve and the burner.

E. Minimum Boiler Efficiencies: Minimum boiler efficiencies are to be as follows at a 20 degree delta-T:

EWT	100% Fire	80% Fire	60%	40% Fire	20% Fire	7% Fire
160 °F	86%	87.41%	87.41%	87.41%	87.47%	87.4%
140 °F	86.2%	88.09%	88.09%	88.09%	88.09%	87.9%
120 °F	89%	89.54%	89.54%	90.18%	90.18%	91.6%
100 °F	93.5%	94.51%	94.51%	95.02%	95.4%	95.9%
80 °F	95.5%	96.5%	96.9%	98.21%	98.34	99.2%

F. Exhaust Manifold: The exhaust manifold to be of corrosion resistant 316L SS with an 8-inch diameter flue connection. The exhaust manifold shall have a collecting reservoir and a gravity drain for the elimination of condensation.

G. Blower: The boiler to include variable-speed, DC centrifugal fans to operate during the burner firing sequence and pre-purge the combustion chamber.

1. Motors: Comply with requirements specified in Division 23 Section "Common Electrical Requirements for HVAC Equipment."

a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

H. Gas Train: Combination gas valve with manual shutoff and pressure regulator. Provide additional regulators as required for simultaneous firing with older packaged burners on phased or hybrid system projects, as required.

I. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.

J. Casing:

1. Jacket: Sheet metal, with snap-in or interlocking closures.
2. Control Compartment Enclosures: NEMA 250, Type 1A.
3. Finish: Baked-enamel or Powder-coated protective finish.
4. Insulation: Minimum 2-inch- thick, mineral-fiber insulation surrounding the heat exchanger.
5. Combustion-Air Connections: Inlet and vent duct collars.

2.3 TRIM

A. Aquastat Controllers: Operating, firing rate, and high limit.

B. Pressure and Temperature Gauge: Minimum 3-1/2-inch- diameter, combination water-pressure and -temperature gauge. Gauges shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.

C. Boiler Air Vent: High capacity automatic.

D. Drain Valve: Minimum NPS 3/4 hose-end gate valve.

E. Circulation Pump: Non-overloading, in-line pump with split-capacitor motor having thermal-overload protection and lubricated bearings; designed to operate at specified boiler pressures and temperatures.

F. Safety Relief Valve:

1. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.
2. Description: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.

   a. Drip-Pan Elbow: Cast iron and having threaded inlet and outlet with threads complying with ASME B1.20.1.

G. Pressure Gage: Minimum 3-1/2-inch diameter. Gage shall have normal operating pressure about 50 percent of full range.

H. Water Column: Minimum 12-inch glass gage with shutoff cocks.

I. Drain Valves: Minimum NPS 3/4 or nozzle size with hose-end connection.

J. Stop Valves: Boiler inlets and outlets, except safety relief valves or preheater inlet and outlet, shall be equipped with stop valve in an accessible location as near as practical to boiler nozzle and same size or larger than nozzle. Valves larger than NPS 2 shall have rising stem.

K. Stop-Check Valves: Factory-installed, stop-check valve and stop valve at boiler outlet with free-blow drain valve factory installed between the two valves and visible when operating stop-check valve.

2.4 CONTROLS

A. Refer to Division 23 Section "Instrumentation and Control for HVAC."

B. Boiler operating controls shall include the following devices and features:

1. Control transformer.

2. Set-Point Adjust: Set points shall be adjustable.
3. Operating Pressure Control: Factory wired and mounted to cycle burner.
4. Low-Water Cutoff and Pump Control: Cycle feedwater pump(s) for makeup water control.
5. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to reset supply-water temperature inversely with outside-air temperature. At 0 deg F outside-air temperature, set supply-water temperature at 180 deg F; at 60 deg F outside-air temperature, set supply-water temperature at 120 deg F.

C. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

1. High Cutoff: Manual reset stops burner if operating conditions rise above maximum boiler design temperature or pressure.
2. Auxiliary Low Water Cut-Off Switches: UL listed float type electronic mercury free safety shutdown switch designed for use external water column mounting on hot water boilers, including manual reset switch; similar to “#150E-M” by McDonnell & Miller.
3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

D. Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms thru BACnet or LONtalk.

1. Hardwired Points:

a. Monitoring: On/off status, common trouble alarm, low water level alarm.
b. Control: On/off operation, hot water supply temperature set-point adjustment.

2. A communication interface with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building automation system.

2.5 ELECTRICAL POWER

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

B. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. House in NEMA 250, Type 12 enclosure.
2. Wiring shall be numbered and color-coded to match wiring diagram.
3. Install factory wiring outside of an enclosure in a metal raceway.

4. Field power interface shall be to non-fused disconnect switch.
5. Provide branch power circuit to each motor and to controls with a disconnect switch or circuit breaker.
6. Provide each motor with overcurrent protection.

2.6 VENTING KITS

A. Products of Combustion: Complete system, ASTM A 959, Type 29-4C double wall stainless steel, pipe, vent terminal, roof thimble, indoor plate, vent adapter, and sealant. Provide each boiler with F&T condensate trap and minimum five gallon (volume measured below level of boiler condensate trap) condensate neutralizing tank.

B. Combustion-Air Intake: Complete system, stainless steel, pipe, vent terminal with screen, inlet air coupling, and sealant.

C. Gas Train Vent Terminations: Internally threaded 90 degree angle fitting of cast aluminum or malleable iron construction, with stainless steel insect (between 10 and 16 mesh) screening disc interference fit to elbow in such a manner as to disengage from fitting under blow off design back pressure, allowing full discharge. Free area through screening shall not be less than free area of required vent pipe size (reducing elbow required). Screen shall be recessed from termination, forming an integral drip and paint protection edge

2.7 SOURCE QUALITY CONTROL

A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

B. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

C. Allow Owner access to source quality-control testing of boilers. Notify Architect 14 days in advance of testing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Beginning installation constitutes Contractor's acceptance of substrates and conditions.

3.2 BOILER INSTALLATION

A. Equipment Mounting: Install boilers on cast-in-place concrete equipment bases as specified in section 23 05 00 – Common Work Results for HVAC. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Install gas-fired boilers according to NFPA 54.

C. Assemble and install boiler trim.

D. Install electrical devices furnished with boiler but not specified to be factory mounted.

E. Install control wiring to field-mounted electrical devices.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Division 23 Section "Hydronic Piping."

E. Install new gas trains and gas piping in accordance with burner manufacturer's printed instructions and recommendations and as follows. Piping shall be full size shown on drawings through drop to boiler and drip leg, with stop valve in riser, with lateral to boiler at least full size of gas train, connected to boiler gas-train inlet with union. Run gas train vent piping outdoors; terminate minimum 24" above roof as specified. Confirm piping arrangement and location of vent termination in field with Architect

F. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

G. Install piping from safety relief valves to nearest floor drain or as otherwise directed. Provide union as required for side service access, and secure at base.

H. Boiler Venting:

1. Install flue venting kit and combustion-air intake.
2. Connect full size to boiler connections. Comply with requirements in Division 23 Section "Breechings, Chimneys, and Stacks."
3. Pipe all condensate from boiler condensate drains and breeching / chimney condensate drains through neutralizing tank to floor drain.

I. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

J. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

   a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.
   b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Remove and replace malfunctioning units and retest as specified above.

D. Performance Tests:

1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
3. Perform field performance tests to determine capacity and efficiency of boilers.

   a. Test for full capacity.
   b. Test for boiler efficiency at low fire 20, 40, 60, 80, and 100 percent of full capacity. Determine efficiency at each test point.

4. Repeat tests until results comply with requirements indicated.

5. Provide analysis equipment required to determine performance.
6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.
7. Notify Architect in advance of test dates.
8. Document test results in a report and submit to Architect.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Video training sessions**.** Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 52 16

SECTION 236500 - COOLING TOWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Closed-circuit, induced-draft, counterflow cooling towers.

1.3 DEFINITIONS

A. BMS: Building management system.

B. FRP: Fiber-reinforced polyester.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, pressure drop, fan performance data, rating curves with selected points indicated, furnished specialties, and accessories.

   1. Maximum flow rate.
   2. Minimum flow rate.
   3. Drift loss as percent of design flow rate.
   4. Volume of water in suspension for purposes of sizing a remote storage tank.
   5. Sound power levels in eight octave bands for operation with fans off, fans at minimum, and design speed.
   6. Performance curves for the following:

      a. Varying entering-water temperatures from design to minimum.
      b. Varying ambient wet-bulb temperatures from design to minimum.
      c. Varying water flow rates from design to minimum.
      d. Varying fan operation (off, minimum, and design speed).

   7. Fan airflow, brake horsepower, and drive losses.
   8. Pump flow rate, head, brake horsepower, and efficiency.
   9. Motor amperage, efficiency, and power factor at 100, 75, 50, and 25 percent of nameplate horsepower.
   10. Electrical power requirements for each cooling tower component requiring power.

B. Shop Drawings: Complete set of manufacturer's prints of cooling tower assemblies, control panels, sections and elevations, and unit isolation. Include the following:

1. Assembled unit dimensions.
2. Weight and load distribution.
3. Required clearances for maintenance and operation.
4. Sizes and locations of piping and wiring connections.
5. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For cooling tower support structure indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of support structure.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
3. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Structural supports.
2. Piping roughing-in requirements.
3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

B. Certificates: For certification required in "Quality Assurance" Article.

C. Source quality-control reports.

D. Field quality-control reports.

E. Startup service reports.

F. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each cooling tower to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by CTI.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. ASME Compliance: Fabricate and label heat-exchanger coils to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. CTI Certification: Cooling tower thermal performance according to CTI STD 201, "Certification Standard for Commercial Water-Cooling Towers Thermal Performance."

F. FMG approval and listing in the latest edition of FMG's "Approval Guide."

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace the following components of cooling towers that fail in materials or workmanship within specified warranty period:

1. Fan assembly including fan, drive, and motor.
2. All components of cooling tower.
3. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CLOSED-CIRCUIT, INDUCED-DRAFT, COUNTERFLOW COOLING TOWERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. EVAPCO, Inc.
2. Recold.

3. Baltimore Air Coil.

B. Fabricate cooling tower mounting base with reinforcement strong enough to resist cooling tower movement during a seismic event when cooling tower is anchored to field support structure.

C. Cooling tower designed to resist wind load of 30 lbf/sq. ft.

D. Casing and Frame:

1. Casing Material: Galvanized steel, ASTM A 653/A 653M, G210 coating.
2. Frame Material: Galvanized steel, ASTM A 653/A 653M, G210 coating.
3. Fasteners: Galvanized steel.
4. Joints and Seams: Sealed watertight.
5. Welded Connections: Continuous and watertight.

E. Collection Basin: Configure tower for installation with a field-constructed collection basin.

F. Collection Basin:

1. Material: Stainless steel.
2. Overflow and drain connections.
3. Makeup water connection.

G. Electric/Electronic, Collection Basin Water-Level Controller with Solenoid Valve:

1. Enclosure: NEMA 250, Type 4.
2. Sensor: Solid-state controls with multiple electrode probes and relays factory wired to a terminal strip to provide control of water makeup valve, low- and high-level alarms, and output for shutoff of pump on low level.
3. Electrode Probes: Stainless steel.
4. Water Stilling Chamber: Corrosion-resistant material.
5. Solenoid Valve: Slow closing with stainless-steel body; controlled and powered through level controller in response to water-level set point.
6. Electrical Connection Requirements: 120 V, single phase, 60 Hz.

H. Electric Basin Heater:

1. Stainless-Steel Electric Immersion Heaters: Installed in a threaded coupling on the side of the collection basin.
2. Heater Control Panel: Mounted on the side of each cooling tower cell.
3. Enclosure: NEMA 250, Type 4.
4. Magnetic contactors controlled by a temperature sensor/controller to maintain collection basin water-temperature set point. Water-level probe shall monitor cooling tower water level and de-energize the heater when the water reaches low-level set point.
5. Control-circuit transformer with primary and secondary side fuses.
6. Terminal blocks with numbered and color-coded wiring to match wiring diagram.
7. Single-point, field-power connection to a fused disconnect switch and heater branch circuiting complying with NFPA 70.

8. Factory Wiring Method: Metal raceway for factory-installed wiring outside of enclosures, except make connections to each electric basin heater with liquid tight conduit.

I. Pressurized Water Distribution Piping: Main header and lateral branch piping designed for even distribution over heat-exchanger coil or fill throughout the flow range without the need for balancing valves and for connecting individual, removable, nonclogging spray nozzles.

1. Pipe Material: PVC.
2. Spray Nozzle Material: PVC.
3. Piping Supports: Corrosion-resistant hangers and supports to resist movement during operation and shipment.

J. Recirculating Piping: PVC, with connections for separately provided, remote spray pump.

K. Spray Pump: Close-coupled, end-suction, single-stage, bronze-fitted centrifugal pump; with suction strainer and flow balancing valve, and mechanical seal suitable for outdoor service.

L. General Requirements for Spray Pump Motor: Comply with NEMA designation and temperature-rating requirements specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment" and not indicated below.

1. Motor Enclosure: Totally enclosed fan cooled (TEFC) with epoxy or polyurethane finish.
2. Energy Efficiency: Comply with ASHRAE/IESNA 90.1.
3. Service Factor: 1.15.

M. Heat-Exchanger Coils:

1. Tube and Tube Sheet Materials: Stainless-steel tube and sheet.
2. Heat-Exchanger Arrangement: Serpentine tubes with removable cover plate on inlet and outlet headers; and sloped for complete drainage of fluid by gravity.
3. ASME Compliance: Designed, manufactured, and tested according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1 and bearing ASME "U" stamp; and sloped for complete drainage of fluid by gravity.
4. Field Piping Connections: Vent, supply, and return suitable for mating to ASME B16.5, Class 150 flange.Retain option in first paragraph below to limit placement of drift eliminators.

N. Removable Drift Eliminator:

1. Material: PVC; with maximum flame-spread index of 25 according to ASTM E 84.
2. UV Treatment: Inhibitors to protect against damage caused by UV radiation.
3. Configuration: Multipass, designed and tested to reduce water carryover to achieve performance indicated.

O. Air-Intake Louvers:

1. Material: Matching casing.

2. UV Treatment: Treat louvers with inhibitors to protect against damage caused by UV radiation.
3. Louver Blades: Arranged to uniformly direct air into cooling tower, to minimize air resistance, and to prevent water from splashing out during all modes of operation including operation with fans off.

P. Axial Fan: Balanced at the factory after assembly.

1. Blade Material: Aluminum.
2. Hub Material: Aluminum.
3. Blade Pitch: Field adjustable.
4. Protective Enclosure: Removable, galvanized-steel, wire-mesh screens complying with OSHA regulations.
5. Fan Shaft Bearings: Self-aligning ball or roller bearings with moisture-proof seals and premium, moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F. Bearings designed for an L-10 life of 50,000 hours.
6. Bearings Grease Fittings: Extended lubrication lines to an easily accessible location.

Q. Belt Drive:

1. Service Factor: 1.5 based on motor nameplate horsepower.
2. Sheaves: Fan and motor shafts shall have taper-lock sheaves fabricated from corrosion-resistant materials.
3. Belt: Multiple V-belt design with a matched set of cogged belts.
4. Belt: One-piece, multigrooved, solid-back belt.
5. Belt Material: Oil resistant, nonstatic conducting, and constructed of neoprene polyester cord.
6. Belt-Drive Guard: Comply with OSHA regulations.
7. Two-Motor, Single-Fan Drive:

    a. Two single-speed motors per fan, one sized for full speed and load and the other sized for 67 percent of full-load speed.
    b. Each motor with belt drive and configured for operation when other motor fails.
    c. Controls and wiring same as two-speed, two-winding motor.

R. Fan Motor:

1. General Requirements for Fan Motors: Comply with NEMA designation and temperature-rating requirements specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment" and not indicated below.
2. Motor Enclosure: Totally enclosed fan cooled (TEFC) with epoxy or polyurethane finish.
3. Energy Efficiency: Comply with ASHRAE/IESNA 90.1.
4. Service Factor: 1.15.
5. Insulation: Class F.
6. Variable-Speed Motors: Inverter-duty rated per NEMA MG-1, Section IV, "Performance Standard Applying to All Machines," Part 31, "Definite-Purpose, Inverter-Fed, Polyphase Motors."

7. Motor Base: Adjustable, or other suitable provision for adjusting belt tension.

S. Fan Discharge Stack: Material shall match casing, manufacturer's standard velocity recovery design.

1. Stack Extension: Fabricated to extend above fan deck 36 inches unless otherwise indicated.
2. Stack Termination: Wire-mesh, galvanized-steel screens; complying with OSHA regulations.

T. Vibration Switch: For each fan drive.

1. Enclosure: NEMA 250, Type 4.
2. Vibration Detection: Sensor with a field-adjustable, acceleration-sensitivity set point in a range of 0 to 1 g and frequency range of 0 to 3000 cycles per minute. Cooling tower manufacturer shall recommend switch set point for proper operation and protection.
3. Provide switch with manual-reset button for field connection to a BMS and hardwired connection to fan motor electrical circuit.
4. Switch shall, on sensing excessive vibration, signal an alarm through the BMS and shut down the fan.

U. Controls: Comply with requirements in Section 23 09 00 "Instrumentation and Control for HVAC."

V. Control Package: Field installed or wired. Panel to be provided by M. Davis & Sons or approved manufacturer.

1. NEMA 250,Type 4 enclosure with removable internally mount backplate.
2. Control-circuit transformer with primary and secondary side fuses.
3. Terminal blocks with numbered and color-coded wiring to match wiring diagram. Spare wiring terminal block for connection to external controls or equipment.
4. Microprocessor-based controller for automatic control of fan and spray pump based on cooling tower leaving-water temperature with control features to improve operating efficiency based on outdoor ambient wet-bulb temperature by using adaptive logic.
5. VFD drive control fan speed based on leaving water temperature. VFD to include electronic by-pass and service disconnect switch.
6. Collection basin electric/electronic level controller complying with requirements in "Electric/Electronic, Collection Basin Water-Level Controller with Solenoid Valve" Paragraph.
7. Electric basin heaters with temperature control and low-water-level safety switch for each cell, complying with requirements in "Electric Basin Heater" Paragraph.
8. Vibration switch for each fan, complying with requirements in "Vibration Switch" Paragraph.
9. Single-point, field-power connection to a fused disconnect switch for each cooling tower cell.

    a. Branch power circuit to each motor and electric basin heater and to controls with a disconnect switch or circuit breaker.
    b. NEMA-rated motor controller, hand-off-auto switch, and overcurrent protection for each motor. Provide variable frequency controller with manual bypass and line reactors for each variable-speed motor indicated.

10. Field-installed wiring outside of enclosures shall be in metal raceway, except make connections to each motor and electric basin heater with liquid-tight conduit.
11. Visual indication of status and alarm with momentary test push button for each motor.
12. Audible alarm and silence switch.
13. Visual indication of elapsed run time, graduated in hours for each motor.
14. Cooling tower shall have hardware to enable BMS to remotely monitor and display the following:

    a. Operational status of each motor.
    b. Cooling tower leaving-fluid temperature.
    c. Fan vibration alarm.
    d. Collection basin high- and low-water-level alarms.

W. Personnel Access Components:

1. Doors: Large enough for personnel to access cooling tower internal components from both cooling tower end walls. Doors shall be operable from both sides of the door.
2. External Ladders with Safety Cages: Aluminum, galvanized-steel, fixed ladders with ladder extensions to access external platforms and top of cooling tower from adjacent grade without the need for portable ladders. Comply with 29 CFR 1910.27.
3. External Platforms with Handrails: Aluminum, or galvanized-steel bar grating at cooling tower access doors when cooling towers are elevated and not accessible from grade.
4. Handrail: Aluminum, or galvanized steel complete with kneerail and toeboard, around top of cooling tower. Comply with 29 CFR 1910.23.
5. Internal Platforms: Aluminum, or galvanized-steel bar grating.

    a. Spanning the collection basin from one end of cooling tower to the other and positioned to form a path between the access doors. Platform shall be elevated so that all parts are above the high water level of the collection basin.
    b. Elevated internal platforms with handrails accessible from fixed vertical ladders to access the fan drive assembly when out of reach from collection basin platform.

X. Cooler shall be provided with finned coils to provide 100% capacity in the dry mode of operation at or below the dry bulb switchover temperature of 50.2 degrees.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before cooling tower installation, examine roughing-in for tower support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting tower performance, maintenance, and operation.

1. Cooling tower locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install cooling towers on support structure indicated.

B. Equipment Mounting:

1. Install cooling towers on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."

C. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Maintain manufacturer's recommended clearances for service and maintenance.

E. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to cooling towers to allow service and maintenance.

C. Install flexible pipe connectors at pipe connections of cooling towers mounted on vibration isolators.

D. Provide drain piping with valve at cooling tower drain connections and at low points in piping.

E. Connect cooling tower overflows and drains, and piping drains to sanitary sewage system.

F. Domestic Water Piping: Comply with applicable requirements in Section 22 11 16 "Domestic Water Piping." Connect to water-level control with shutoff valve and union, flange, or mechanical coupling at each connection.

G. Supply and Return Piping: Comply with applicable requirements in Section 23 21 13 "Hydronic Piping" and Section 23 21 16 Hydronic Piping Specialties." Connect to entering cooling tower connections with shutoff valve, balancing valve, thermometer, plugged tee with pressure gage, flow meter, and drain connection with valve. Connect to leaving cooling tower connection with shutoff valve. Make connections to cooling tower with a flange coupling.

H. Equalizer Piping: Piping requirements to match supply and return piping. Connect an equalizer pipe, full size of cooling tower connection, between tower cells. Connect to cooling tower with shutoff valve.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform field tests and inspections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections: Comply with ASME PTC 23, "ASME Performance Test Codes - Code on Atmospheric Water Cooling Equipment."

E. Cooling towers will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Obtain performance data from manufacturer.

1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

a. Clean entire unit including basins.
b. Verify that accessories are properly installed.
c. Verify clearances for airflow and for cooling tower servicing.
d. Check for vibration isolation and structural support.
e. Lubricate bearings.
f. Verify fan rotation for correct direction and for vibration or binding and correct problems.
g. Adjust belts to proper alignment and tension.
h. Verify proper oil level in gear-drive housing. Fill with oil to proper level.
i. Operate variable-speed fans through entire operating range and check for harmonic vibration imbalance. Set motor controller to skip speeds resulting in abnormal vibration.
j. Check vibration switch setting. Verify operation.
k. Verify water level in tower basin. Fill to proper startup level. Check makeup water-level control and valve.
l. Verify operation of basin heater and control.

m. Verify that cooling tower air discharge is not recirculating air into tower or HVAC air intakes. Recommend corrective action.
n. Replace defective and malfunctioning units.

D. Start cooling tower and associated water pumps. Follow manufacturer's written starting procedures.

E. Prepare a written startup report that records the results of tests and inspections.

3.6 ADJUSTING

A. Set and balance water flow to each tower inlet.

B. Adjust water-level control for proper operating level.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cooling towers.

END OF SECTION 236500

SECTION 23 72 00 - AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fixed-plate sensible heat exchangers.
2. Fixed-plate total heat exchangers.

1.3 PERFORMANCE REQUIREMENTS

A. No condensate shall form anywhere on or around the complete unit that is not controlled by condensate pans and directed to drain though condensate piping provided as a part of this Contract.

1.4 SUBMITTALS, GENERAL

A. General: Submit all action submittals and informational submittals required by this Section concurrently.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For air-to-air energy recovery equipment. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, elevations, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which equipment or suspension systems will be attached.

1.7 CLOSEOUT SUBMITTALS

A. Field quality-control reports.
B. Operation and Maintenance Data: For air-to-air energy recovery equipment to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ARI Compliance:

1. Capacity ratings for air-to-air energy recovery equipment shall comply with ARI 1060, "Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment."

C. ASHRAE Compliance:

1. Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
2. Capacity ratings for air-to-air energy recovery equipment shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."

D. NRCA Compliance: Roof curbs for roof-mounted equipment shall be constructed according to recommendations of NRCA.

E. UL Compliance:

1. Packaged heat recovery ventilators shall comply with requirements in UL 1812, "Ducted Heat Recovery Ventilators"; or UL 1815, "Nonducted Heat Recovery Ventilators."
2. ETL listed and wired according to the NEC with UL listed power components.

F. Unit shall comply with NFPA 90A requirements for flame spread and smoke generation, including the unit insulation.

G. Air flow data shall be in accordance with AMCA 210 testing method.

1.9 COORDINATION

A. Coordinate layout and installation of air-to-air energy recovery equipment and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordinate sizes and locations of equipment supports and roof penetrations with actual equipment provided.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air-to-air energy recovery equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Packaged Energy Recovery Units: One year.
2. Warranty Period for Fixed-Plate Total Heat Exchangers: 10 years.

1.11 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set of each type of filter specified.
2. Fan Belts: One set of belts for each belt-driven fan in energy recovery units.
3. Wheel Belts: One set of belts for each heat wheel.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Acceptance at Site

1. Inspect the factory packaging before opening and note any damage on the packing slip. Unpack and inspect the unit before acceptance. Dents or scratches of the casing of the unit, or substantial damage to the packing materials that may indicate internal damage to the unit, shall be cause for rejection of the unit.

B. Storage and Protection

1. After acceptance on site, until such time as the unit is being actively installed, package the unit in protective materials and stored in a protected location so as to protect the function and appearance of the unit in the as accepted condition.

PART 2 - PRODUCTS

2.1 PACKAGED ENERGY RECOVERY UNITS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Applied Air; Mestek Technology, Inc.
2. Carnes.
3. Des Champs Technologies.
4. Greenheck Fan Corporation.
5. Loren Cook Company.
6. RenewAire LLC.
7. Trane; American Standard Companies, Inc.
8. Wing, L. J.; Mestek Technology, Inc.

B. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Housing: Manufacturer's standard construction with corrosion-protection coating and exterior finish, gasketed and calked weathertight**,** hinged access doors, removable panels with neoprene gaskets for inspection and access to internal parts, minimum 2 inch thick thermal insulation, knockouts for electrical and piping connections, exterior drain connection, and lifting lugs.

1. Inlet: Weatherproof hood or louver, with damper for exhaust and supply.

a. Exhaust: Spring-return, two-position, motor-operated damper.
b. Supply: Spring-return, two-position, motor-operated damper.

D. Heat Recovery Device: Fixed-plate heat exchanger.

E. Supply and Exhaust Fans: Forward-curved, centrifugal fan with spring isolators and insulated flexible duct connections.

1. Motor and Drive: Drive type indicated on Drawings.
2. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Electrical Requirements for HVAC Equipment."
3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
5. Spring isolators on each fan having 1 inch static deflection.

F. Extended-Surface, Disposable Panel Filters:

1. Comply with NFPA 90A.

2. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.

3. Factory-fabricated, dry, extended-surface type.

4. Thickness: 2 inches.

5. Minimum Arrestance: 90, according to ASHRAE 52.1.

6. Minimum Merv: 8, according to ASHRAE 52.2.

7. Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.

8. Media-Grid Frame: Galvanized steel

9. Mounting Frames: Welded, galvanized steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.

G. Piping and Wiring: Fabricate units with space within housing for piping and electrical conduits. Wire motors and controls so only external connections are required during installation.

1. Indoor Enclosure: NEMA 250, Type 12 enclosure contains relays, starters, and terminal strip.
2. Include fused disconnect switches.
3. Variable-speed controller to vary fan capacity from 100 to approximately 50 percent.

H. Accessories:

1. Roof Curb: Aluminum with gasketing, and factory-installed wood nailer; complying with NRCA standards; minimum height of 12 inches or as otherwise indicated.

2. Intake weather hood with 2-inch- thick filters.

3. Louvered intake weather hood with 2-inch- thick filters in V-bank configuration.

4. Exhaust weather hood with birdscreen.

5. Low-Leakage, Isolation Dampers: Double-skin, airfoil-blade, extruded-aluminum dampers with compressible jamb seals and extruded-vinyl blade edge seals, in opposed blade arrangement with cadmium-plated steel operating rods rotating in sintered bronze or nylon bearings mounted in a single extruded-aluminum frame, with operating rods connected with a common linkage, and electric damper operator factory wired. Leakage rate shall not exceed 5 cfm/sq. ft. at 1-inch wg and 9 cfm/sq. ft. at 4-inch wg .

6. Isolation Dampers: Opposed-blade, extruded-aluminum dampers with cadmium-plated steel operating rods rotating in sintered bronze or nylon bearings mounted in a single extruded-aluminum frame with operating rods connected with a common linkage, and

electric damper operator factory wired. Blades shall have gaskets and edge seals, and shall be mechanically fastened to operating rod.

7. Duct flanges.

8. Rubber-in-shear isolators for ceiling-mounted units.

9. Hinged access doors with quarter-turn latches.

10. Drain pans for condensate removal complying with ASHRAE 62.1.

11. Automatic, in-place, spray-wash system.

12. Weatherproofing for tilt-control system.

2.2 CONTROLS

A. Refer to Building Automation Spec Sections 23 09 00.

B. Carbon Monoxide Sensor: Adjustable control from 600 to 2000 ppm for duct mounting with digital display and computer/building management system interface to energize unit.

1. Locate eight (8) CO Sensors throughout the building.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before air-to-air energy recovery equipment installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for electrical services to verify actual locations of connections before installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 INSTALLATION

A. Install fixed-plate heat exchangers so supply and exhaust airstreams flow in opposite directions.

1. Install duct access doors in both supply and exhaust ducts, both upstream and downstream, for access to heat exchanger. Access doors and panels are specified in Division 23 Section "Air Duct Accessories."

B. Roof Curb: Install air-to-air energy recovery equipment on curbs and coordinate roof penetrations and flashing with roof construction specified in Division 07 Section "Roof Accessories." Secure air-to-air energy recovery equipment to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

C. Unit Support: Install unit level on structural [**curbs**] [**rails**]. Coordinate wall penetrations and flashing with wall construction. Secure air-to-air energy recovery equipment to structural support with anchor bolts.

D. Suspended Units: Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

E. Install units with clearances for service and maintenance.

F. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

G. Pipe drains from units and drain pans to nearest floor drain; use same size as condensate drain connection.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Division 23 Section "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to unit to allow service and maintenance.

C. Connect piping to units mounted on vibration isolators with flexible connectors.

D. Comply with requirements for ductwork specified in Division 23 Section "Air Ducts."

E. Electrical Connections: Comply with applicable requirements in Division 26 Sections.

1. Install electrical devices furnished with units but not factory mounted.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Adjust seals and purge.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Set initial temperature and humidity set points.
5. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

D. Air-to-air energy recovery equipment will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy recovery units.

END OF SECTION 23 72 00

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes split-system heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. LEED Submittals:

1. Product Data for Credit EA 4: Documentation indicating that equipment and refrigerants comply.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

D. Samples for Initial Selection: For units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: Two (2) set(s) for each unit.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: Five year(s) from date of Substantial Completion.
b. For Parts: Five year(s) from date of Substantial Completion.

c. For Labor: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Friedrich Air Conditioning Company.
2. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
3. SANYO North America Corporation; SANYO Fisher Company.

2.2 INDOOR UNITS (5 TONS OR LESS)

A. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
4. Fan: Direct drive, centrifugal.
5. Fan Motors:

   a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
   b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
   c. Enclosure Type: Totally enclosed, fan cooled.
   d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
   e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
   f. Mount unit-mounted disconnect switches on interior of unit.

6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Condensate Drain Pans:

   a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
2) Depth: A minimum of 1 inch deep.

b. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.

c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on [one end] [both ends] of pan.

1) Minimum Connection Size: NPS 1.

d. Pan-Top Surface Coating: Asphaltic waterproofing compound.

8. Air Filtration Section:

a. General Requirements for Air Filtration Section:

1) Comply with NFPA 90A.
2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

b. Disposable Panel Filters:

1) Factory-fabricated, viscous-coated, flat-panel type.
2) Thickness: 1 inch.
3) Merv according to ASHRAE 52.2: 5.
4) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
5) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

B. Variable-Frequency Controllers:

1. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, three-phase induction motor by adjusting output voltage and frequency.
2. Output Rating: Three-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.
3. Unit Operating Requirements:

a. Input ac voltage tolerance of 208 V, plus or minus 5 percent.
b. Input-frequency tolerance of 06/11 Hz, plus or minus 6 percent.
c. Minimum Efficiency: 96 percent at 60 Hz, full load.
d. Minimum Displacement Primary-Side Power Factor: 96 percent.
e. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
f. Starting Torque: 100 percent of rated torque or as indicated.

g. Speed Regulation: Plus or minus 1 percent.

4. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.
5. Internal Adjustability Capabilities:

   a. Minimum Speed: 5 to 25 percent of maximum rpm.
   b. Maximum Speed: 80 to 100 percent of maximum rpm.
   c. Acceleration: 2 seconds to a minimum of 22 seconds.
   d. Deceleration: 2 seconds to a minimum of 22 seconds.
   e. Current Limit: 50 percent to a minimum of 110 percent of maximum rating.

6. Self-Protection and Reliability Features:

   a. Input transient protection by means of surge suppressors.
   b. Undervoltage and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
   c. Adjustable motor overload relays capable of NEMA ICS 2, Class 20 performance.
   d. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
   e. Instantaneous line-to-line and line-to-ground overcurrent trips.
   f. Loss-of-phase protection.
   g. Reverse-phase protection.
   h. Short-circuit protection.
   i. Motor overtemperature fault.

7. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads, spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.
8. Power-Interruption Protection: Prevents motor from re-energizing after a power interruption until motor has stopped.
9. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
10. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back, based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
11. Door-mounted, digital status lights shall indicate the following conditions:

    a. Power on.
    b. Run.
    c. Overvoltage.
    d. Line fault.
    e. Overcurrent.
    f. External fault.

12. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual-speed-control potentiometer and elapsed-time meter.

13. Meters or digital readout devices and selector switch, mounted flush in controller door and connected, to indicate the following controller parameters:

    a. Output frequency (Hertz).
    b. Motor speed (rpm).
    c. Motor status (running, stop, fault).
    d. Motor current (amperes).
    e. Motor torque (percent).
    f. Fault or alarming status (code).
    g. Proportional-integral-derivative feedback signal (percent).
    h. DC-link voltage (volts dc).
    i. Set-point frequency (Hertz).
    j. Motor output voltage (volts).

14. Control Signal Interface:

    a. Electric Input Signal Interface: A minimum of two analog inputs (0 to 10 V or 0/4-20 mA) and six programmable digital inputs.
    b. Remote signal inputs capable of accepting any of the following speed-setting input signals from the control system:

        1) 0 to 10-V dc.
        2) 0-20 or 4-20 mA.
        3) Potentiometer using up/down digital inputs.
        4) Fixed frequencies using digital inputs.
        5) RS485.
        6) Keypad display for local hand operation.

    c. Output signal interface with a minimum of one analog output signal (0/4-20 mA), which can be programmed to any of the following:

        1) Output frequency (Hertz).
        2) Output current (load).
        3) DC-link voltage (volts dc).
        4) Motor torque (percent).
        5) Motor speed (rpm).
        6) Set-point frequency (Hertz).

    d. Remote indication interface with a minimum of two dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

        1) Motor running.
        2) Set-point speed reached.
        3) Fault and warning indication (overtemperature or overcurrent).
        4) High- or low-speed limits reached.

15. Communications: RS485 interface allows VFC to be used with an external system within a multidrop LAN configuration. Interface shall allow all parameter settings of VFC to be

programmed via BMS control. Provide capability for VFC to retain these settings within the nonvolatile memory.

16. Integral Disconnecting Means: NEMA AB 1, instantaneous-trip circuit breaker with lockable handle.
17. Accessories:

    a. Devices shall be factory installed in controller enclosure unless otherwise indicated.
    b. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.
    c. Standard Displays:

        1) Output frequency (Hertz).
        2) Set-point frequency (Hertz).
        3) Motor current (amperes).
        4) DC-link voltage (volts dc).
        5) Motor torque (percent).
        6) Motor speed (rpm).
        7) Motor output voltage (volts).

2.3 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

    a. Compressor Type: Scroll.
    b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
    c. Refrigerant Charge: R-410A.
    d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.

3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 45 deg F.
7. Mounting Base: Polyethylene.

2.4 ACCESSORIES

A. Control equipment and sequence of operation are specified in Section 23 09 00 "Instrumentation and Control for HVAC" and Section 23 09 93 "Sequence and Operations for HVAC Controls."

B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

C. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection including auto setting.

D. Automatic-reset timer to prevent rapid cycling of compressor.

E. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

F. Drain Hose: For condensate.

G. Additional Monitoring:

1. Monitor constant and variable motor loads.
2. Monitor variable-frequency-drive operation.
3. Monitor economizer cycle.
4. Monitor cooling load.
5. Monitor air distribution static pressure and ventilation air volumes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Equipment Mounting:

1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.

3. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."

D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 23 81 46 - WATER-SOURCE UNITARY HEAT PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of water-source heat pumps:

1. Concealed horizontal or vertical units, 6 tons and smaller.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals (except Samples for Verification) and informational submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each model.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.

2. Structural members to which heat pumps will be attached.

3. Method of attaching hangers to building structure.

4. Size and location of initial access modules for acoustical tile.

5. Items penetrating finished ceiling, including the following:

   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.

B. Product Certificates: For each type of water-source heat pump, signed by product manufacturer.

C. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.
B. Operation and Maintenance Data: For water-source heat pumps to include in emergency, operation, and maintenance manuals.
C. Warranty: Executed special warranty specified in this Section.

1.7 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water-source heat pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

   1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ASHRAE Compliance:

   1. ASHRAE 15.
   2. Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. Comply with NFPA 70.

F. Comply with safety requirements in UL 484 for assembly of free-delivery water-source heat pumps.

G. Comply with safety requirements in UL 1995 for duct-system connections.

1.8 COORDINATION

A. Coordinate layout and installation of water-source heat pumps and suspension components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components, and partition assemblies.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water-source heat pumps that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, refrigeration components.
2. Warranty Period: Five years from date of Substantial Completion.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. One set of matched fan belts for each belt-driven fan.
2. One set of filters for each unit.

PART 2 - PRODUCTS

2.1 CONCEALED WATER-SOURCE HEAT PUMPS, 6 TONS AND SMALLER

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work includes the following:

1. FHP Manufacturing Inc.
2. Mammoth Inc.
3. McQuay International.
4. Trane.
5. WaterFurnace International, Inc.

B. Description: Packaged water-source heat pump with temperature controls; factory assembled, tested, and rated according to ARI-ISO-13256-1.

C. Cabinet and Chassis: Galvanized-steel casing with the following features:

1. Access panel for access and maintenance of internal components.

2. Knockouts for electrical and piping connections.

3. Flanged duct connections.

4. Cabinet Insulation: Glass-fiber liner, minimum 1/2 inch thick, complying with UL 181.

5. Condensate Drainage: Stainless-steel drain pan with condensate drain piping projecting through unit cabinet and complying with ASHRAE 62.1.

6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

7. Sound Attenuation Package:

   a. Minimum 0.598-inch thick compressor enclosure and front panel. Minimum 0.0937-inch thick foam gasket around the compressor and perimeter of end panel.
   b. Sound attenuating blanket over compressor.

D. Fan: Direct driven, centrifugal, with multispeed motor resiliently mounted in fan inlet.

1. General requirements for motors are specified in Division 23 Section "Common Electrical Requirements for HVAC Equipment."
2. Motor: Multispeed, permanently lubricated, ECM motor.

E. Water Circuit:

1. Refrigerant-to-Water Heat Exchangers:

   a. Coaxial heat exchangers with copper water tube with enhanced heat-transfer surfaces inside a steel shell; both shell and tube leak tested to 450 psig on refrigerant side and 400 psig on water side. Factory mounted heat exchanger in unit on resilient rubber vibration isolators.

2. Water Regulating Valves: Limit water flow through refrigerant-to-water heat exchanger, and control head pressure on compressor during cooling and heating. Valves shall close when heat-pump compressor is not running.

3. Motorized Water Valve: Stop water flow through the unit when compressor is off.

F. Refrigerant-to-Air Coils: Copper tubes with aluminum fins, leak tested to 450 psig.

G. Refrigerant Circuit Components:

1. Sealed Refrigerant Circuit: Charge with R-410A refrigerant.

2. Filter-Dryer: Factory installed to clean and dehydrate the refrigerant circuit.

3. Charging Connections: Service fittings on suction and liquid for charging and testing.

4. Reversing Valve: Pilot-operated sliding-type valve designed to be fail-safe in heating position with replaceable magnetic coil.

5. Compressor: Hermetic rotary or scroll compressor installed on vibration isolators and housed in an acoustically treated enclosure with factory-installed safeties as follows:

    a. Antirecycle timer.
    b. High-pressure cutout.
    c. Low-pressure cutout or loss of charge switch.
    d. Internal thermal-overload protection.
    e. Freezestat to stop compressor if water-loop temperature in refrigerant-to-water heat exchanger falls below 35 deg F.
    f. Condensate overflow switch to stop compressor with high condensate level in condensate drain pan.

6. Refrigerant Piping Materials: ASTM B 743 copper tube with wrought-copper fittings and brazed joints.

7. Pipe Insulation: Refrigerant minimum 3/8-inch thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-development indexes according to ASTM E 84.

8. Refrigerant Metering Device: Capillary tube.

9. Refrigerant Metering Device: Thermal expansion valve to allow specified operation with entering-water temperatures from 25 to 125 deg F.

H. Filters: Disposable, pleated type, 1 inch thick and with a minimum of 90 percent arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value of 7 according to ASHRAE 52.2.

I. Control equipment and sequence of operation are specified in Division 23 Sections "Instrumentation and Controls for HVAC".

J. Controls:

1. Basic Unit Controls:

    a. Low- and high-voltage protection.
    b. Overcurrent protection for compressor and fan motor.
    c. Random time delay, three to ten seconds, start on power up.
    d. Time delay override for servicing.
    e. Control voltage transformer.

2. Thermostat:

    a. Wall-mounted temperature sensor.

    b. Unoccupied period override push button.

c. LED to indicate fault condition at heat pump.

d. Data entry and access port.

1) Input data include room temperature and humidity set points for occupied and unoccupied periods.
2) Output data include room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.

3. Terminal Controller:

a. Scheduled operation for occupied and unoccupied periods on 365-day clock with minimum 4 programmable periods per day.
b. Two-hour unoccupied period override period.
c. Remote control panel to contain programmable timer and LED for fault condition.
d. Compressor disable relay to stop compressor operation for demand limiting or switch to unoccupied operation.
e. Automatic restart after five minutes if fault clears. Lockout after three attempts to restart following fault. Indicate fault for service technician.
f. Return-air temperature high-limit (firestat). Stop unit on high temperature.
g. Backup for volatile memory.
h. Differential pressure switch to indicate fan status. Fan failure alarm.
i. Differential pressure switch to indicate filter status. Dirty filter alarm.

4. BAS interface requirements as further described in Division 23 Sections "Instrumentation and Controls for HVAC".

a. Interface relay for scheduled operation.

b. Interface relay to provide indication of fault at central workstation.

c. Provide BAC-net or LONtalk interface for central BAS workstation for the following functions:

1) Set-point adjustment for set points identified in this Section.
2) Start/stop and operating status of heat-pump unit.
3) Data inquiry to include supply air, room air temperature and humidity, and entering-water temperature.
4) Occupied and unoccupied schedules.

K. Electrical Connection: Single electrical connection with fused disconnect.

2.2 HOSE KITS

A. General: Hose kits shall be designed for minimum 400 psig working pressure, and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.

B. Hose: Length 36 inches. Minimum diameter, equal to water-source heat-pump connection size.

C. Isolation Valves: Two-piece bronze-body ball valves with stainless-steel ball and stem and galvanized-steel lever handle. Provide valve for supply and return. If balancing device is combination shutoff type with memory stop, the isolation valve may be omitted on the return.

D. Strainer: Y-type with blowdown valve in supply connection.

E. Balancing Device: Mount in return connection. Include meter ports to allow flow measurement with differential pressure gage.

1. Automatic balancing valve, factory set to operate within 10 percent of design flow rate over a 40:1 differential pressure range of 2 to 80 psig.
2. Manual, calibrated-orifice balancing valve.
3. Manual, venturi-type balancing valve.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of water-source heat pumps.

B. Examine roughing-in for piping and electric installations for water-source heat pumps to verify actual locations of piping connections and electrical conduit before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 INSTALLATION

A. Suspend water-source heat pumps from structure with threaded steel rods and minimum 0.25-inch static deflection rubber-in-shear vibration isolators.

B. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls or as required in Division 23 Section "Instrumentation and Control for HVAC."

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Connect supply and return hydronic piping to heat pump with hose kits.

2. Connect heat-pump condensate drain pan to indirect waste connection with condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.

B. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts. Specific connection requirements are as follows:

1. Connect supply and return ducts to water-source heat pumps with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."

C. Install electrical devices furnished by manufacturer but not specified to be factory mounted.

D. Install piping adjacent to machine to allow service and maintenance.

E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. After installing water-source heat pumps and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.

2. Inspect for visible damage to compressor, coils, and fans.

3. Inspect internal insulation.

4. Verify that labels are clearly visible.

5. Verify that clearances have been provided for servicing.

6. Verify that controls are connected and operable.

7. Verify that filters are installed.

8. Adjust vibration isolators.

9. Inspect operation of barometric dampers.

10. Verify bearing lubrication on fan.

11. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.

12. Adjust fan belts to proper alignment and tension.

13. Start unit according to manufacturer's written instructions.

14. Complete startup sheets and attach copy with Contractor's startup report.

15. Inspect and record performance of interlocks and protective devices; verify sequences.

16. Operate unit for an initial period as recommended or required by manufacturer.

17. Verify thermostat and humidistat calibration.

18. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.

19. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.

20. Start refrigeration system and measure and record the following:

    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.

21. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Return-air volume.

c. Relief-air volume.
d. Outdoor-air intake volume.

3.6 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.7 CLEANING

A. Replace filters used during construction prior to air balance or substantial completion.

B. After completing installation of exposed, factory-finished water-source heat pumps, inspect exposed finishes and repair damaged finishes.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water-source heat pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 81 46

SECTION 23 82 00 – TERMINAL HEATING AND COOLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes unit ventilators, blower-coil units, fan-coil units, convectors, fin tube radiation, unit heaters, air coils and accessories with the following heating and cooling features:

1. Hydronic heating coil.

1.3 DEFINITIONS

A. HGBP: Hot-gas bypass.

1.4 SUBMITTALS, GENERAL

A. General: Submit all action submittals and informational submittals required by this Section concurrently.

1.5 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for each unit type and configuration.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Plans, elevations, sections, and details.
2. Details of anchorages and attachments to structure and to supported equipment.
3. Wiring Diagrams: Power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension components.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Size and location of access panels in hard ceilings to provide access to concealed units.
5. Items penetrating finished ceiling, including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.

6. Perimeter moldings.
7. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
8. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Warranty: Special warranty specified in this Section.

1.7 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For unit ventilators blower-coil units, fan-coil units, convectors, fin tube radiation, unit heaters, and air coils to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

C. Warranty: Executed special warranty specified in this Section.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.9 COORDINATION

A. Coordinate layout and installation of all units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate size and location of wall sleeves for outdoor-air intake and relief dampers.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Compressor failure.
b. Condenser coil leak.

2. Warranty Period: Five years from date of Substantial Completion.
3. Period (Condenser Coil Only): Five years from date of Substantial Completion.

1.11 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Unit Ventilator Filters: Furnish Insert number spare filter(s) for each filter installed.
2. Fan-Coil Filters: Furnish Insert number spare filter(s) for each filter installed.
3. Blower-Coil Filters: Furnish Insert number spare filter(s) for each filter installed.
4. Spare Cooling Chassis: Furnish Insert number spare integral cooling chassis for each size unit installed.

PART 2 - PRODUCTS

2.1 FAN-COIL UNITS BLOWER COIL UNITS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Carrier Corporation.
2. Environmental Technologies, Inc.
3. McQuay International.
4. Trane.
5. YORK International Corporation.

B. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

C. Coil Section Insulation: 1/2-inch 1-inch thick, coated glass fiber foil-covered, closed-cell foam matte-finish, closed-cell foam complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

D. Main and Auxiliary Drain Pans: Plastic Stainless steel Insulated galvanized steel with plastic liner. Fabricate pans and drain connections to comply with ASHRAE 62.1. Drain pans shall be removable.

E. Chassis: Galvanized steel where exposed to moisture. Floor-mounting units shall have leveling screws.

F. Cabinet: Steel with baked-enamel finish in manufacturer's standard paint color as selected by Architect.

1. Vertical Unit Front Panels: Removable, steel, with integral stamped polyethylene steel discharge grille and channel-formed edges, cam fasteners, and insulation on back of panel.
2. Horizontal Unit Bottom Panels: Fastened to unit with cam fasteners and hinge and attached with safety chain; with integral stamped cast-aluminum discharge grilles.
3. Stack Unit Discharge and Return Grille: Aluminum double-deflection discharge grille, and louvered- or panel-type return grille; color as selected by Architect from manufacturer's standard custom colors. Return grille shall provide maintenance access to fan-coil unit.
4. Steel recessing flanges for recessing fan-coil units into ceiling or wall.

G. Outdoor-Air Wall Box: Minimum 0.1265-inch- thick, aluminum, rain-resistant louver and box with integral eliminators and bird screen.

1. Louver Configuration: Horizontal Vertical, rain-resistant louver.
2. Louver Material: Aluminum Steel.
3. Bird Screen: 1/2-inch mesh screen on interior side of louver.
4. Decorative Grille: On outside of intake.
5. Finish: Anodized aluminum Baked enamel, color as selected by Architect from manufacturer's standard colors.

H. Outdoor-Air Damper: Galvanized-steel blades with edge and end seals and nylon bearings; with shaft ready to accept electronic pneumatic, two-position modulating actuators.

I. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Washable Foam: 70 percent arrestance and 3 MERV.
2. Glass Fiber Treated with Adhesive: 80 percent arrestance and 5 MERV.
3. Pleated Cotton-Polyester Media: 90 percent arrestance and 7 MERV.

J. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

K. Fan and Motor Board: Removable.

1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Electrical Requirements for HVAC Equipment."
3. Wiring Termination: Connect motor to chassis wiring with plug connection.

L. Factory, Hydronic Piping Package: ASTM B 88, Type L copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.

1. Two-way modulating control valve for chilled-water coil.
2. Three-way modulating control valve for heating coil.
3. Hose Kits: Minimum 400-psig working pressure, and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.

   a. Length: 24 inches 36 inches.
   b. Minimum Diameter: Equal to fan-coil-unit connection size.

4. Two-Piece Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.
5. Automatic Flow-Control Valve: Brass or ferrous-metal body; 300-psig working pressure at 250 deg F, with removable, corrosion-resistant, tamperproof, self-cleaning piston spring; factory set to maintain constant indicated flow with plus or minus 10 percent over differential pressure range of 2 to 80 psig.
6. Y-Pattern Hydronic Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 hose-end, full-port, ball-type blowdown valve in drain connection.
7. Wrought-Copper Unions: ASME B16.22.
8. Risers: ASTM B 88, Type L copper pipe with hose and ball valve for system flushing.

M. Control devices and operational sequences are specified in Division 23 Sections "Instrumentation and Control for HVAC".

N. Electrical Connection: Factory wire motors for a single electrical connection. Provide factory mounted unit disconnect.

2.2 DUCTED FAN-COIL BLOWER-COIL UNITS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Carrier Corporation.
2. Environmental Technologies, Inc.
3. McQuay International.
4. Trane.
5. YORK International Corporation.

B. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

C. Coil Section Insulation: 1/2-inch 1-inch thick coated foil-faced glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Drain Pans: Plastic Stainless steel Insulated galvanized steel with plastic liner. Fabricate pans and drain connections to comply with ASHRAE 62.1.

E. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panels.

F. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.

1. Supply-Air Plenum: Sheet metal plenum finished and insulated to match the chassis with mill-finish, aluminum, double-deflection grille.
2. Return-Air Plenum: Sheet metal plenum finished to match the chassis.
3. Mixing Plenum: Sheet metal plenum finished and insulated to match the chassis with outdoor- and return-air, formed-steel dampers.
4. Dampers: Galvanized steel with extruded-vinyl blade seals, flexible-metal jamb seals, and interlocking linkage.

G. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Washable Foam: 70 percent arrestance and 3 MERV.
2. Glass Fiber Treated with Adhesive: 80 percent arrestance and 5 MERV.
3. Pleated Cotton-Polyester Media: 90 percent arrestance and 7 MERV.

H. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.

I. Belt-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the cabinet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.

   1. Motors: Comply with requirements in Division 23 Section "Common Electrical Requirements for HVAC Equipment."

J. Factory, Hydronic Piping Package: ASTM B 88, Type L copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.

   1. Two-way modulating control valve for chilled-water coil.
   2. Three-way modulating control valve for heating coil.
   3. Hose Kits: Minimum 400-psig working pressure, and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.

      a. Length: 24 inches 36 inches.
      b. Minimum Diameter: Equal to fan-coil-unit connection size.

   4. Two-Piece Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.
   5. Automatic Flow-Control Valve: Brass or ferrous-metal body; 300-psig working pressure at 250 deg F; with removable, corrosion-resistant, tamperproof, self-cleaning piston spring; factory set to maintain constant indicated flow with plus or minus 10 percent over differential pressure range of 2 to 80 psig.
   6. Y-Pattern Hydronic Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig working pressure, with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 hose-end, full-port, ball-type blowdown valve in drain connection.
   7. Wrought-Copper Unions: ASME B16.22.

K. Control devices and operational sequence are specified in Division 23 Section "Instrumentation and Control for HVAC".

L. Electrical Connection: Factory wire motors and controls for a single electrical connection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for piping and electrical connections to verify actual locations before unit installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 INSTALLATION

A. Install unit ventilators, blower-coil units, fan-coil units, convectors, fin tube radiation, unit heaters, and air coils to comply with NFPA 90A.

B. Suspend horizontal unit ventilators, blower-coil units, fan-coil units, and convectors, from structure with threaded steel rods and minimum 0.25-inch static-deflection, elastomeric vibration isolation hanger 1.0-inch static-deflection spring hangers. Vibration isolators are specified in Division 23 Section "Mechanical Sound, Vibration, and Siesmic Control."

C. Refer to Division 23 Section "Packaged Compressor and Condenser Units" for condensing units matched to refrigerant cooling coil packaged in unit ventilators.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Install piping adjacent to machine to allow service and maintenance.
2. Connect piping to unit ventilator, blower-coil units, and fan-coil units factory hydronic piping package. Install piping package if shipped loose.
3. Connect condensate drain to indirect waste.

B. Install refrigerant piping as required by Division 23 Section "Refrigerant Piping," and add refrigerant as required to compensate for length of piping.

C. Connect supply and return ducts to unit ventilators, blower-coil units, and fan-coil units with flexible duct connectors specified in Division 23 Section "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.

D. Ground equipment according to Division 26 Section.

E. Connect wiring according to Division 26 Section.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.

3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
4. Record temperatures entering and leaving energy recovery wheel when outdoor-air temperature is a minimum of 15 deg F higher, or 20 deg F lower, than room temperature.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 82 00

SECTION 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and to all of Divisions 26.

1.2 SUMMARY

A. Section Includes:

1. General requirements applicable to components and systems included in Electric Contract.

B. Products Installed but Not Furnished Under This Section

1. Make electrical connections to equipment shown on Drawings and furnished by other Contractors. Obtain approved wiring diagrams and location drawings for roughing in and final connections from Contractor furnishing equipment.

1.3 REFERENCES

A. ANSI American National Standards Institute

B. ASTM ASTM International

C. IEEE Institute of Electrical and Electronics Engineers, Inc. (The)

D. IES Illuminating Engineering Society of North America

E. NBFU National Board of Fire Underwriters

F. NEC National Electrical Code

G. NEMA National Electrical Manufacturers' Association

H. NETA International Electrical Testing Association

I. NFPA National Fire Protection Association

J. UL Underwriters' Laboratories, Inc.

1.4 DEFINITIONS

A. “Provide”: Furnish and install new equipment.

1.5 SYSTEM DESCRIPTIONS

A. Testing of Existing Systems: Test each existing system scheduled for modification in presence of Authorized Owner’s Representative and issue report to Owner and Architect listing conditions found prior to any removals, relocations, or additions. Modified systems include (but are not limited to):

1. Power distribution.
2. Emergency lighting.

B. Design Requirements - Provide complete systems, properly tested, balanced, and ready for operation including necessary details, items and accessories although not expressly shown or specified, including (but not limited to):

1. Wiring and raceway for work specified in Project Manual and shown on Drawings.
2. Electrical devices and equipment for work specified in Project Manual and shown on Drawings.
3. Systems included, but not limited to:

a. Electrical distribution.
b. Electrical connections.
c. Lighting.
d. Emergency lighting.

C. Electric Layouts: Arrange panels; disconnect switches, enclosed breakers, equipment, raceways, and similar components neatly, orderly and symmetrically. Provide 3/4-inch galvanized slotted channel steel for surface mounted panels, disconnect switches, enclosed breakers, and similar equipment. Arrangements shown on Drawings are diagrammatic only; provide and adjust raceways, wiring, and other components as required.

D. Power Interruptions and Scheduled Outages: Coordinate scheduling of power interruptions and outages with General Contractor.

1.6 SUBMITTALS, GENERAL

A. General: Submit all action submittals required by this Section concurrently.

1.7 ACTION SUBMITTALS

A. Shop Drawings:

1. Electric Layouts: Submit detailed drawings showing exact sizes and locations for approval before beginning work.

B. Samples:

1. Factory-Finished Surfaces: On all submittals, indicate standard factory color. Where more than one color is available, selection made by Architect from manufacturer's full range of colors.

1.8 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Codes and Standards: Comply with applicable Federal, State and local building and electrical codes, laws, ordinances, and regulations, and comply with applicable NFPA, National Electrical Code and utility company requirements and regulations. Provide Underwriters Laboratories Seal on all materials.
2. Permits and Inspections: Obtain approvals, tests, and inspections required by Architect, Engineer, local electrical inspector, agent or agency specified in Project Manual, or National, State, or local codes and ordinances.

    a. Schedule electrical inspection by an agency acceptable to the local authority having jurisdiction and submit final inspection certificate to Architect.
    b. Furnish materials and labor necessary for tests and pay costs associated with tests and inspections.
    c. Conduct tests under load for load balancing and where required by codes, regulations, ordinances, or technical Specification.

3. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

1.9 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection:

1. Take precautions to store materials and products to protect finishes and not permit dust and dirt to penetrate equipment.
2. Replace equipment damaged beyond reasonable repair as required by Architect.
3. Refinish any equipment with marks, stains, scratches, dents, and other aesthetic damage that doesn’t impede operation of equipment as required by Architect.

1.10 COORDINATION OF WORK

A. New Construction:

1. Openings, Chases, Recesses, Sleeves, Lintels and Bucks (required for admission of Electric Contract systems and components): Coordinate requirements with General Contractor for inclusion in General Contract. Furnish necessary information (e.g.

locations and sizes) to General Contractor in ample time for installation of systems and components included in Electric Contract.

2. Anchor Bolts: Deliver to Contractor responsible for General Work anchor bolts required for Electric Contract construction that are to be installed in construction included in General Contract.
3. Locate settings, check locations as installation in General Contract progresses, and provide templates or holding fixtures as required to maintain proper accuracy.

B. Existing Construction: Unless otherwise specified, employ Contractor responsible for General Work for all cutting, patching, repairing and replacing of general work required for installation of systems and components included in Electric Work. Secure approval from Architect's representative before cutting.

1. Anchor Bolts: Deliver to Contractor responsible for General Work anchor bolts required for Electric Work construction that are to be installed in construction included in General Contract. Provide templates or holding fixtures as required to maintain proper accuracy.

1.11 ALTERATION PROCEDURES

A. In locations where existing devices are indicated to be disconnected and removed and existing power circuit or communications cable is not scheduled to be reused:

1. Remove circuit conductors back to source.

2. Modify panel directory for that circuit.

3. Remove all existing exposed and accessible raceway; coordinate with General Contractor and Architect.

4. Provide blank cover plates or wall infill (as indicated on plans) and as described below:

a. For single gang and multi-gang switch boxes in public or occupied spaces; stainless steel coverplates.
b. For single gang and multi-gang boxes in un-occupied spaces; stainless steel, galvanized steel.
c. For boxes larger than standard switch boxes in public or occupied spaces; remove existing box and provide wall infill, matching existing sub-surface and finished surface conditions. Coordinate with General Contractor.
d. For boxes larger than standard switch boxes in un-occupied spaces; 18 gage galvanized sheet metal coverplate with machined edges. Coordinate with General Contractor.

B. In locations where existing devices are to remain in place, ensure circuits feeding such devices remain operational. Modify existing circuits as required to allow new construction to occur and to maintain necessary circuitry to existing devices for complete and proper operation.

C. In locations where entire existing system is being removed or modified:

1. Refer to individual system specification sections for documentation and testing requirements prior to any alteration work on any system.
2. Take all necessary measures to ensure that down time will not compromise safety.
3. Notify Owner, Architect and other Contractors not less than 2 weeks prior to interruptions in service.
4. Coordinate work schedule to minimize duration of system outage during hours when building is occupied.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. Do not cut waterproofed floors or walls for admission of any equipment or materials and do not pierce any structural members without written permission from Architect.

B. Furnish and install sleeves, inserts, panels, raceways, boxes, and similar infrastructure., ahead of general construction work and maintain Contractor personnel at Site during installation of general construction work to be responsible for and to maintain these items in position.

C. Unless otherwise noted elsewhere in Contract Documents, bear expense of cutting, patching, repairing or replacing of work of other trades made necessary by any fault, error or tardiness on part of Electrical Contract or damage done by Electric Contract. Employ and pay Contractor whose work is involved.

3.2 DEMONSTRATION OF COMPLETE ELECTRICAL SYSTEMS

A. Thoroughly demonstrate and instruct Owner's designated representative in care and operation of electrical systems and equipment furnished and installed in Electric Contract.

1. System Operator: Maintain competent operator at building for at least 2 days in 2 consecutive weeks after Owner takes occupancy of major parts of building to operate systems and equipment in presence of Owner's representative.
2. Factory Representative: In addition to demonstration and instruction specified above, provide technically qualified factory representatives from manufacturers of major equipment, to train Owner's representatives in care and operation of applicable products as specified in applicable technical sections of Division 26.
3. Coordinate and schedule time and place of all training through the Architect at the Owner’s convenience.

4. Submit letters attesting to satisfactory completion of instructions, including date of completion of instruction, names of persons in attendance, and signature of Owner's authorized representative.
5. Architect's representative must be present when Owner's representatives participate in instruction.
6. The following equipment and systems are included:

    a. Fire alarm system.

END OF SECTION 26 05 00

SECTION 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTOR AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.
3. Sleeves and sleeve seals for cables.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Senator Wire & Cable Company.
4. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THW THHN-THWN XHHW UF USE and SO.

D. Multiconductor Cable: Comply with NEMA WC 70 for armored cable, Type AC metal-clad cable, Type MC.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.4 SLEEVE SEALS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: EPDM NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Plastic Carbon steel Stainless steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. All wires and cable shall be 98% conductivity copper, single conductor in all sizes. Wire in sizes # 8 AWG and smaller may be solid conductor. Wire size s # 6 AWG and larger shall be stranded. Interior wiring and wiring in dry locations shall have type THWN insulation. Exterior wiring and wiring in damp or wet locations shall have type THWN insulation.

B. Wiring installed in flexible steel conduit shall be stranded conductor in all sizes. Maximum length shall be limited to 3'-0".

C. All wiring shall be color coded or identified in an approved manner. Color coding shall be consistent throughout the work, i.e., same color used for same phase leg, one color switch legs, etc. In all cases, ground conductor shall be green.

D. On systems 208Y/120 VAC, the following color code shall be observed:

Phase	A.	Black
	B.	Red
	C.	Blue
	Neut.	White

E. On systems 480/277 VAC, the following color code shall be observed:

Phase	A.	Brown
	B.	Orange
	C.	Yellow
	Neut.	Grey

F. Minimum wire size shall be as follows:

Control and Signal= # 14 AWG
Power and Lightning= # 12 AWG

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Underground feeders and distribution circuits: Type THHN-THWN in Schedule 40 PVC raceway rated for underground application.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway Armored cable, Type AC Metal-clad cable, Type MC.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway Armored cable, Type AC Metal-clad cable, Type MC.

D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway Armored cable, Type AC Metal-clad cable, Type MC.

E. Class 1 Control Circuits: Type THHN-THWN, in raceway.

F. Class 2 Control Circuits: Type THHN-THWN, in raceway Power-limited cable, concealed in building finishes Power-limited tray cable, in cable tray.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches 12 inches of slack.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS (See also Section 26 05 44)

A. Coordinate sleeve selection and application with selection and application of firestopping.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
2. For sleeve rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both wall surfaces.

G. Extend sleeves installed in floors 2 inches above finished floor level.

H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint.

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials.

L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION (See also Section 26 05 44)

A. Install to seal underground exterior-wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Electrical Installer shall engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

D. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 05 19

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Grounding systems and equipment.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Ground rods.
2. Ground rings.
3. Grounding for sensitive electronic equipment.

1.4 QUALITY ASSURANCE

A. Comply with UL 467 for grounding and bonding materials and equipment.

B. The required grounding/bonding for the electrical system shall meet the ancillary system performance requirements.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch- thick.

2.2 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches below grade.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING OVERHEAD LINES

A. Comply with IEEE C2 grounding requirements.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch grounding bus.
3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. For grounding electrode system, install at least three (3) rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

D. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

E. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

3.1 LABELING

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.

1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

D. Grounding system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 5 ohms.

G. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five <5> times the applied force.

1.5 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details and include calculations for the following.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

a. Allied Tube & Conduit.
b. Thomas & Betts Corporation.
c. Unistrut; Tyco International, Ltd.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- diameter holes at a maximum of 8 inches o.c., in at least 1 surface.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. Fabco Plastics Wholesale Limited.

2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.

3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
4. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

1. J-Hooks: Comply with NECA 1 NEC 300.11 and standard of compliance T1A-568 and T1A-569.

D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:

(1) Hilti Inc.
(2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
(3) MKT Fastening, LLC.
(4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:

(1) Cooper B-Line, Inc.; a division of Cooper Industries.

(2) Empire Tool and Manufacturing Co., Inc.
(3) Hilti Inc.
(4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
(5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete "

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Division 09 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 05 33 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. LFNC: Liquidtight flexible nonmetallic conduit.

H. NBR: Acrylonitrile-butadiene rubber.

I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members in the paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

D. Qualification Data: For professional engineer and testing agency.

E. Source quality-control test reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

C. The required ‘grounding/bonding for the electrical system shall meet the elevator and ancillary systems’ performance requirements.

D. When installed outdoors, or at other wet locations, the conduit/raceway/boxes shall be “NEMA 4”.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit; a Tyco International Ltd. Co.
3. O-Z Gedney; a unit of General Signal.

B. Rigid Steel Conduit: ANSI C80.1.

1. Rigid steel conduit shall be UL listed, and in accordance with the latest edition of Federal Specification WW-C-581, and ANSI Standard C80.1. Rigid steel conduit shall be zinc coated on the outside, and either zinc-coated, or coated with an approved corrosion resistant coating on the inside.
2. Fittings for rigid steel conduit shall be in accordance with the latest edition of Federal Specification W-F-408, except that material shall be either iron or steel only.

C. IMC: ANSI C80.6.

1. PVC-Coated Steel Conduit: PVC-coated IMC.Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

D. EMT: ANSI C80.3.

1 Electrical metallic tubing (EMT) shall be UL listed and in accordance with the latest edition of UL 797 and ANSI Standard C80.3. EMT shall be zinc-coated on the outside and shall be either zinc-coated with an approved corrosion resistant coating on the inside.

2. Couplings and connectors for EMT shall be made of either steel or malleable iron only, shall be "Concrete tight" or "Rain tight" and shall be the gland and ring compression type. All connectors shall have insulated throats.

E. FMC: Zinc-coated steel

1. Flexible metal conduit ("Greenfield") shall be UL listed, and in accordance with the latest edition of Federal Specification WW-C-566.

2. Fittings for flexible metal conduit shall be made of either steel or malleable iron only, shall have insulated throats, and shall be of one of the following types:

a. Wedge and screw type having an angular wedge fitting between the convolutions of the conduits.

b. Squeeze or clamp type having a bearing surface contoured to wrap around the conduit and clamped by one or more screws.

F. LFMC: Flexible steel conduit with PVC jacket.

1. Liquid tight flexible metal conduit shall be UL listed, and consist of a core flexible galvanized steel tubing over which is an extruded, a liquid tight jacket of polyvinyl chloride (PVC).

2. Fittings for liquid tight flexible conduit shall be of a type with a nylon or equal plastic compression ring and a gland for tightening. Fittings shall be made of either steel or malleable iron only, shall have insulated throats and shall be of type having male thread and locknut or male bushing with or without "O" ring seal. Each connector shall provide a low resistance ground connection between the flexible conduit and the outlet box, conduit or other equipment to which it is connected.

G. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.

2. Fittings for EMT: set-screw or compression type.

3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch with overlapping sleeves protecting threaded joints.

H. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

I. Rigid non-metallic conduit shall not be used. In cases where expressed permission is granted by the Engineer, conduit shall be Schedule 40 polyvinyl chloride, unless otherwise noted. Conduit shall be UL listed. Appropriately sized ground wire shall be run in all non-metallic conduit.

1. Fittings for rigid non-metallic conduit if used shall be polyvinyl chloride, sleeve type, applied with a solvent recommended by the manufacturer.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

1. AFC Cable Systems, Inc.
2. CANTEX Inc.
3. CertainTeed Corp.; Pipe & Plastics Group.
4. Thomas & Betts Corporation.

B. ENT: NEMA TC 13.

C. LFNC: UL 1660.

D. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

E. Fittings for LFNC: UL 514B.

F. Conduits, Fitings & Enclosures located in Elevator Shaft: NEMA 4.

2.3 METAL WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

1. Square D; Schneider Electric.
2. Cooper B-Line, Inc.
3. Hoffman.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type

E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

a. Thomas & Betts Corporation.
b. Walker Systems, Inc.; Wiremold Company (The).
c. Wiremold Company (The); Electrical Sales Division.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard custom colors.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

a. Panduit Corp.
b. Walker Systems, Inc.; Wiremold Company (The).
c. Wiremold Company (The); Electrical Sales Division.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

1. Hoffman.
2. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
3. Thomas & Betts Corporation.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Metal Floor Boxes: Cast or sheet metal, rectangular.

F. Nonmetallic Floor Boxes: Nonadjustable, round.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

I. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

J. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.6 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.7 SLEEVE SEALS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: All exposed conduits to be installed in rigid steel conduit.
2. Exposed, Not Subject to Severe Physical Damage: All exposed conduits to be installed in rigid steel conduit.
3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit IMC. Includes raceways in the following locations:

    a. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: All exposed conduits to be installed in rigid steel conduit.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: Rigid steel conduit or IMC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

B. Minimum Raceway Size 3/4-inch trade size.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

D. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

K. Raceways for Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

M. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

N. Set metal floor boxes level and flush with finished floor surface.

O. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 2 inches above finished floor level.

H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials.

L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.4 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.5 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.6 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks.
2. Handholes and boxes.
3. Manholes.

1.2 ACTION SUBMITTALS

A. Product Data: For accessories for manholes, handholes, and boxes.

B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Reinforcement details.
3. Frame and cover design and manhole frame support rings.
4. Step details.
5. Grounding details.
6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
7. Joint details.

C. Shop Drawings for Factory-Fabricated Handholes and Boxes: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Cover design.
3. Grounding details.
4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC: NEMA TC 2, Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Beck Manufacturing.
2. CertainTeed Corp.; Pipe & Plastics Group.
3. Manhattan/CDT; a division of Cable Design Technologies.

B. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type EB-20-PVC, ASTM F 512, UL 651A, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.

C. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

2.3 HANDHOLES AND BOXES

A. Description: Comply with SCTE 77.

1. Color: Gray.
2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC." or "TELEPHONE." As indicated for each service.

6. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Fiberglass Handholes and Boxes with Polymer Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. Christy Concrete Products.
d. Hubbell Inc.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of fiberglass.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carson Industries LLC.
b. Christy Concrete Products.
c. Nordic Fiberglass, Inc.
d. Hubbell Inc.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Section 017329 "Cutting and Patching."

3.2 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches 12.5 feet 25 feet, both horizontally and vertically, at other locations, unless otherwise indicated.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
3. Grout end bells into structure walls from both sides to provide watertight entrances.

E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

G. Pulling Cord: Install 100-lbf-test nylon cord in ducts, including spares.

H. Concrete-Encased Ducts: Support ducts on duct separators.

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion

fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.

b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.

3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
7. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.
8. Stub-Ups: Use manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Extend concrete encasement throughout the length of the elbow.
9. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
   b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.

10. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

I. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.

3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes less than 6 inches in nominal diameter.
4. Install backfill as specified in Section 312000 "Earth Moving."
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
6. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and signal ducts.
7. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
10. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

11. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

3.3 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch above finished grade.

D. Install handholes and boxes with bottom below the frost line.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.4 GROUNDING

A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.6 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 26 05 43

SECTION 26 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Advance Products & Systems, Inc.
b. CALPICO, Inc.
c. Metraflex Company (The).

3. Sealing Elements: EPDM or Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
4. Pressure Plates: Stainless steel.
5. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
2. Sealant shall have VOC content according to 40 CFR 59, Subpart D (EPA Method 24).
3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.

4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 05 44

SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those

required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.2 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.5 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

2.6 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a black background. Minimum letter height shall be 3/8 inch.

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.7 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black except where used for color-coding.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

J. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.

b. Colors for 208/120-V Circuits:

(a) Phase A: Black.
(b) Phase B: Red.
(c) Phase C: Blue.
(d) Neut.: White

c. Colors for 480/277-V Circuits:

a) Phase A: Brown.
b) Phase B: Orange.
c) Phase C: Yellow.
d) Neut,: Gray

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

B. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

C. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

D. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

E. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

a. Power transfer switches.
b. Controls with external control power connections.

F. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

G. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Adhesive film label with clear protective overlay unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high.

2. Equipment to Be Labeled with Engraved Laminated Label:

a. Panelboards.

b. Switchboards.
c. Enclosed switches.
d. Enclosed circuit breakers.
e. Enclosed controllers.
f. Contactors.
g. Remote-controlled switches, dimmer modules, and control devices.
h. Disconnect switches.
i. Fire Alarm Control Panel (FACP) and Fire Alarm Remote Annunciator Panels
j. Transformers.

3. Identify Power Source and Power Source location on Disconnect Switches, Panelboards, Controllers, etc.

END OF SECTION 26 05 53

SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Coordinate with the following specification sections:
- Section 260574 – Overcurrent Protective Device ARC-Flash Study
- Section 260573 – Overcurrent Protective Device Coordination Study

1.2 SUMMARY

A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.3 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.

1. Short-circuit study input data, including completed computer program input data sheets.
2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.

    a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.
    b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Short-Circuit Study Specialist or Field Adjusting Agency.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.5 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Short-Circuit Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

A. Software Developers: Subject to compliance with requirements, provide software by one of the following or available software developers offering software that may be used for the Work:

1. ESA Inc.
2. Operation Technology, Inc.
3. Power Analytics, Corporation.
4. SKM Systems Analysis, Inc.

B. Comply with IEEE 399 and IEEE 551.

C. Analytical features of fault-current-study computer software program shall have the capability to calculate mandatory features as listed in IEEE 399.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Comments and recommendations for system improvements, where needed.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.

G. Short-Circuit Study Output:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

   a. Voltage.
   b. Calculated fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Calculated asymmetrical fault currents:

      1) Based on fault-point X/R ratio.
      2) Based on calculated symmetrical value multiplied by 1.6.
      3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. No AC Decrement (NACD) ratio.
    e. Equivalent impedance.
    f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
    g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Obtain all data necessary for the conduct of the study.

1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the following input data to support the short-circuit study:

1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
7. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
8. Motor horsepower and NEMA MG 1 code letter designation.
9. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

F. The calculations shall include the ac fault-current decay from induction motors. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

G. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:

1. Electric utility's supply termination point.
2. Incoming switchgear.
3. Low-voltage switchgear.
4. Motor-control centers.
5. Control panels.
6. Automatic transfer switches.
7. Branch circuit panelboards.
8. Disconnect switches.

3.3 ADJUSTING

A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.4 DEMONSTRATION

A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION 260572

SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Coordinate with the following specification sections:

- Section 260572 Overcurrent Protective Device Short-Circuit Study
- Section 260574 Overcurrent Protective Device ARC-Flash Study

1.2 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.

1. Coordination-study input data, including completed computer program input data sheets.
2. Study and equipment evaluation reports.
3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.

    a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Coordination Study Specialist or Field Adjusting Agency.

B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For the overcurrent protective devices to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

   a. The following parts from the Protective Device Coordination Study Report:

      1) One-line diagram.
      2) Protective device coordination study.
      3) Time-current coordination curves.

   b. Power system data.

1.5 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Coordination Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

   1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Coordination Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers: Subject to compliance with requirements, provide software by one of the following or available software developers offering software that may be used for the Work:

   1. ESA Inc.
   2. Operation Technology, Inc.
   3. Power Analytics, Corporation.

4. SKM Systems Analysis, Inc.

B. Comply with IEEE 242 and IEEE 399.

C. Analytical features of device coordination study computer software program shall have the capability to calculate mandatory features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

2.2 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. Calculated asymmetrical fault currents:

1) Based on fault-point X/R ratio.

2) Based on calculated symmetrical value multiplied by 1.6.
3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

F. Protective Device Coordination Study:

1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.

a. Phase and Ground Relays:

1) Device tag.
2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
3) Recommendations on improved relaying systems, if applicable.

b. Circuit Breakers:

1) Adjustable pickups and time delays (long time, short time, ground).
2) Adjustable time-current characteristic.
3) Adjustable instantaneous pickup.
4) Recommendations on improved trip systems, if applicable.

c. Fuses: Show current rating, voltage, and class.

G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

4. Plot the following listed characteristic curves, as applicable:

    a. Power utility's overcurrent protective device.
    b. Low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
    c. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
    d. Transformer full-load current, magnetizing inrush current.
    e. Ground-fault protective devices.
    f. The largest feeder circuit breaker in each motor-control center and panelboard.

5. Provide adequate time margins between device characteristics such that selective operation is achieved.
6. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

    1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 PROTECTIVE DEVICE COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. The study shall be based on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

F. The calculations shall include the ac fault-current decay from induction motors. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

G. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:

1. Electric utility's supply termination point.
2. Switchgear.
3. Low-voltage switchgear.
4. Motor-control centers.
5. Standby generators and automatic transfer switches.
6. Branch circuit panelboards.

H. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the overcurrent protective device study.

1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
2. Use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the following input data to support coordination study. The list below is a guide.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
9. Maximum demands from service meters.
10. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.

11. Motor horsepower and NEMA MG 1 code letter designation.
12. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
13. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Ratings, types, and settings of utility company's overcurrent protective devices.
    c. Special overcurrent protective device settings or types stipulated by utility company.
    d. Time-current-characteristic curves of devices indicated to be coordinated.
    e. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
    f. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
    g. Panelboards, switchboards, motor-control center ampacity, and SCCR in amperes rms symmetrical.

3.4 FIELD ADJUSTING

A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies. Document any revisions and include with as built drawing submittals.

C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

    1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.5 DEMONSTRATION

A. Engage the Coordination Study Specialist to train Owner's maintenance personnel in the following:

    1. Acquaint personnel in the fundamentals of operating the power system in normal and emergency modes.

2. Hand-out and explain the objectives of the coordination study, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting the time-current coordination curves.
3. Adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 260573

SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Coordinate with the following specification sections:

- Section 260572 Overcurrent Protective Device Short Circuit Study
- Section 260573 Overcurrent Protective Device Coordination Study

1.2 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.

1. Arc-flash study input data, including completed computer program input data sheets.
2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.

   a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Arc-Flash Study Specialist or Field Adjusting Agency.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.

B. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.6 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers: Subject to compliance with requirements, provide software by one of the following or available software developers offering software that may be used for the Work:

1. ESA Inc.
2. Operation Technology, Inc.
3. Power Analytics, Corporation.
4. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate mandatory features as listed in IEEE 399.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

F. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Working distance.
6. Incident energy.
7. Hazard risk category.
8. Recommendations for arc-flash energy reduction.

G. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.
2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors and shall apply to low-voltage, three-phase ac systems.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:

1. Electric utility's supply termination point.
2. Switchgear.
3. Low-voltage switchgear.
4. Motor-control centers.
5. Standby generators and automatic transfer switches.
6. Branch circuit panelboards.

3.3 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Use the short-circuit study output and the field-verified settings of the overcurrent devices.

C. Calculate maximum and minimum contributions of fault-current size.

1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include low-voltage equipment locations, except 240-V ac and 208-V ac systems fed from transformers less than 125 kVA.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors shall be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond three to five cycles.

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.4 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.

1. Verify completeness of data supplied on the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the following input data to support coordination study.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.

3. Power sources and ties.
4. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
5. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
6. Motor horsepower and NEMA MG 1 code letter designation.
7. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.5 DEMONSTRATION

A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 260574

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Time switches.
2. Photoelectric switches.
3. Indoor occupancy sensors.
4. Lighting contactors.
5. .

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.
2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. NSi Industries LLC; TORK Products.
4. Tyco Electronics; ALR Brand.

B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
3. Time Delay: Fifteen second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

C. Description: Solid state, with SPST dry contacts rated for 1800 VA, to operate connected load, complying with UL 773.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Thirty-second minimum, to prevent false operation.
4. Lightning Arrester: Air-gap type.
5. Mounting: Twist lock complying with NEMA C136.10, with base.

2.2 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work to include the following:

1. Bryant Electric.
2. Cooper Industries, Inc.
3. Hubbell Building Automation, Inc.
4. Leviton Manufacturing Co., Inc.

5. Lightolier Controls.
6. Lithonia Lighting; Acuity Brands Lighting, Inc.
7. Lutron Electronics Co., Inc.
8. NSi Industries LLC; TORK Products.
9. RAB Lighting.
10. Sensor Switch, Inc.
11. Square D.
12. Watt Stopper.

B. General Requirements for Sensors: Wall mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
5. Mounting:

   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
7. Bypass Switch: Override the "on" function in case of sensor failure.
8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. Dual-Technology Type: Ceiling-mounted, detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is se4lectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.; and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch ceiling.

2.3 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP.
3. Eaton Corporation.
4. General Electric Company; GE Consumer; Industrial - Electrical Distribution; Total Lighting Control.
5. Square D.

B. Description: Electrically operated and electrically held, combination-type lighting contactors with fusible switch, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

C. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors.

1. Monitoring: On-off status.
2. Control: On-off operation.

2.4 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Lighting control devices will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 26 22 00 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.

1.3 ACTION SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Qualification Data: For testing agency.

C. Source quality-control test reports.

D. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

C. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.8 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ACME Electric Corporation; Power Distribution Products Division.
2. Eaton Electrical Inc.; Cutler-Hammer Products.
3. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

C. Cores: One leg per phase.

D. Enclosure: Ventilated, NEMA 250, Type 2.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

E. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: ANSI 49 gray.

F. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

G. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

H. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with NEMA TP 1, Class 1 efficiency levels.
2. Tested according to NEMA TP 2.

I. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.

1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
2. Include special terminal for grounding the shield.
3. Shield Effectiveness:

a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.

J. Wall Brackets: Manufacturer's standard brackets.

K. Fungus Proofing: Permanent fungicidal treatment for coil and core.

L. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

M. Low-Sound-Level Requirements: Maximum sound levels, when factory tested according to IEEE C57.12.91.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

C. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

E. Remove and replace units that do not pass tests or inspections and retest as specified above.

F. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

G. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 26 22 00

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

B. Related Requirements:

1. Section 26 43 13 Surge Protection for Low-Voltage Electrical Power Circuits

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. TVSS: Transient voltage surge suppressor.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.

8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Four spares for each type of panelboard cabinet lock.

2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.10 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager/Owner no fewer than two days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Construction Manager's/Owner's written permission.
3. Comply with NFPA 70E.

1.11 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.12 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Mounted cabinets as shown on drawings.

1. Rated for environmental conditions at installed location.

    a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
6. Finishes:

    a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    b. Back Boxes: Same finish as panels and trim.
    c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

7. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.

B. Incoming Mains Location: Top.

C. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
5. Split Bus: Vertical buses divided into individual vertical sections.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

I. Surge Protective Device

1. In accordance with Specification Section 26 43 13 “Surge Protection for Low-Voltage Electrical Power circuits.”

2.2 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

2.3 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Mains: MCB.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

G. Branch Overcurrent Protective Devices: Fused switches.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: as indicated on the drawings.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

a. Instantaneous trip.
b. Long- and short-time pickup levels.
c. Long- and short-time time adjustments.
d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
e. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
f. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
g. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
h. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
i. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
j. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to panelboards.
5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

C. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

D. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

F. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

G. Install filler plates in unused spaces.

H. Stub four 3/4-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Provide a 4” box and cover for each conduit..

I. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

J. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

F. Panelboards will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

SECTION 262713 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes equipment for electricity metering by Owner.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Dimensioned plans and sections or elevation layouts and wiring diagrams.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Application and operating software documentation.
2. Software licenses.
3. Software service agreement.
4. Hard copies of manufacturer's operating specifications, design user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy Submittal.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion.

Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade his computer equipment if necessary.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY OWNER

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. E-Mon; a division of Hunt Power.
2. National Meter Industries.
3. Square D; a brand of Schneider Electric.

B. General Requirements for Owner's Meters:

1. Comply with UL 1244.
2. Enclosure: NEMA 250, Type 1 minimum, with hasp for padlocking or sealing.
3. Identification: Comply with requirements in Section 260553 "Identification for Electrical Systems."
4. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.
5. Sensors: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.

   a. Type: Split and/or solid core.

6. Current-Transformer Cabinet: Listed or recommended by metering equipment manufacturer for use with sensors indicated.

C. Kilowatt-hour Meter: Electronic single- and three-phase meters, measuring electricity used.

1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
2. Display: LCD with characters not less than 0.25 inch high, indicating accumulative kilowatt-hours and current kilowatt load. Retain accumulated kilowatt-hour in a nonvolatile memory, until reset.
3. Display: Digital electromechanical counter, indicating accumulative kilowatt-hours.

D. Kilowatt-hour/Demand Meter: Electronic single- and three-phase meters, measuring electricity use and demand. Demand shall be integrated over a 15-minute interval.

1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.

2. Display: LCD with characters not less than 0.25 inch high, indicating accumulative kilowatt-hours, current time and date, current demand, and historic peak demand, and time and date of historic peak demand. Retain accumulated kilowatt-hour and historic peak demand in a nonvolatile memory, until reset.

E. Data Transmission Cable: Transmit KY pulse data over Class 1 control-circuit conductors in raceway. Comply with Section 260523 "Control-Voltage Electrical Power Cables."

F. Software: PC based, a product of meter manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install modular meter center according to NECA 400 switchboard installation requirements.

C. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Series Combination Warning Label: Self-adhesive type, with text as required by NFPA 70.

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
2. Turn off circuits supplied by metered feeder and secure them in off condition.
3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.

C. Electricity metering will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 262713

SECTION 26 27 26 – WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Snap switches.
3. Wall-switch.
4. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

B. Related Sections include the following:

1. Division 26 Section "Raceway and Boxes for Electrical System".

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

D. When installed in the elevator hoistway/pit, atop the elevator cab, outdoors, or at other wet locations, the wiring devices shall be “NEMA 4”.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include:

a. Cooper; 5351 (single), 5352 (duplex).
b. Hubbell; HBL5351 (single), CR5352 (duplex).
c. Leviton; 5891 (single), 5352 (duplex).

d. Pass & Seymour; 5381 (single), 5352 (duplex).

B. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Hubbell; CR 5253IG.
b. Leviton; 5362-IG.
3. Pass & Seymour; IG6300.Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.1 GFCI RECEPTACLES

A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; (Non-Feed Type)
b. Pass & Seymour; (Non-Feed Type).

2.2 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include:

a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).

d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

2.1 WALL PLATES

A. Single and combination types to match corresponding wiring devices. Coordinate plate color with Architect.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting.
3. Material for Unfinished Spaces: Galvanized steel Smooth, high-impact thermoplastic.
4. Material for Damp Locations: Thermoplastic Cast or aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum or thermoplastic with lockable cover.

2.2 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color. Coordinate device color with Architect.

1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
2. Isolated-Ground Receptacles: Orange As specified above, with orange triangle on face.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.

3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 26 27 26

SECTION 26 28 16 – SWITCHES AND ENCLOSED BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Shunt trip switches.
4. Molded-case circuit breakers (MCCBs).
5. Molded-case switches.
6. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.
B. NO: Normally open.
C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.

2. Current and voltage ratings.

3. Short-circuit current ratings (interrupting and withstand, as appropriate).

4. Include evidence of NRTL listing for series rating of installed devices.

5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Qualification Data: For qualified testing agency.

D. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Manufacturer's field service report.

F. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Architect and Owner no fewer than 2 weeks in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Square D; a brand of Schneider Electric.

B. Type GD, General Duty, Single Throw, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Mechanical type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.
9. Accessory Control Power Voltage: Remote mounted and powered.

2.2 NONFUSIBLE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Accessory Control Power Voltage: Remote mounted and powered.

2.3 SHUNT TRIP SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

1. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. Littelfuse, Inc.

B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Control Circuit: 120-V ac.

E. Accessories:

1. Oiltight key switch for key-to-test function.
2. Oiltight green ON pilot light.
3. Isolated neutral lug; 200 percent rating.
4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
5. Form C alarm contacts that change state when switch is tripped.
6. Three-pole, double-throw, fire-safety and alarm relay; coil voltage as required.
7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. Comply with requirements, provide product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

J. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.

2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

7. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

8. Alarm Switch: One NC contact that operates only when circuit breaker has tripped.

9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

10. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

11. Electrical Operator: Provide remote control for on, off, and reset operations.

12. Accessory Control Power Voltage: as required.

2.5 MOLDED-CASE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:

1. Standard frame sizes and number of poles.

2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.

7. Alarm Switch: One NC contact that operates only when switch has tripped.

8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.

9. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.

10. Electrical Operator: Provide remote control for on, off, and reset operations.

11. Accessory Control Power Voltage: as required.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
D. Install fuses in fusible devices.
E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following enclosed controllers rated 600 V and less:

1. Full-voltage manual.
2. Full-voltage magnetic.

1.3 DEFINITIONS

A. CPT: Control power transformer.
B. MCCB: Molded-case circuit breaker.
C. MCP: Motor circuit protector.
D. N.C.: Normally closed.
E. N.O.: Normally open.
F. OCPD: Overcurrent protective device.
G. SCR: Silicon-controlled rectifier.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.

1. Show tabulations of the following:

a. Each installed unit's type and details.

b. Factory-installed devices.

c. Nameplate legends.

d. Short-circuit current rating of integrated unit.

e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.

f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.

2. Wiring Diagrams: For power, signal, and control wiring.

C. Qualification Data: For qualified testing agency.

D. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field quality-control reports.

F. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals.

1. Routine maintenance requirements for enclosed controllers and installed components.
2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
3. Manufacturer's written instructions for setting field-adjustable overload relays.
4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

G. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

H. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

D. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 250 W per controller.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Authorized Project Representative no fewer than three (3) days in advance of proposed interruption of electrical systems.
2. Indicate method of providing temporary utilities.
3. Do not proceed with interruption of electrical systems without Authorized Project Representative’s written permission.
4. Comply with NFPA 70E.

1.8 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
c. Square D; a brand of Schneider Electric.

2. Configuration: Nonreversing.

3. Surface mounting.

4. Red pilot light.

C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
c. Square D; a brand of Schneider Electric.

2. Configuration: Nonreversing.

3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button, bimetallic type.

4. Surface mounting.

5. Red pilot light.

D. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

   a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   c. Square D; a brand of Schneider Electric.

2. Configuration: Nonreversing.

3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button, bimetallic type.

4. Surface mounting.

5. Red pilot light.

E. Magnetic Controllers: Full voltage, across the line, electrically held.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

   a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   c. Square D; a brand of Schneider Electric.

2. Configuration: Nonreversing.

3. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.

   a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.

4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.

5. Control Circuits: obtained from integral CPT, with primary and secondary fuses with control power source of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.

    a. CPT Spare Capacity: 100 VA.

6. Solid-State Overload Relay:

   a. Switch or dial selectable for motor running overload protection.
   b. Sensors in each phase.
   c. Class 10 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
   d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
   e. Analog communication module.

7. N.C., isolated overload alarm contact.

8. External overload reset push button.

F. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

   a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   c. Square D; a brand of Schneider Electric.

2. Fusible Disconnecting Means:

   a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class J fuses.
   b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
   c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

3. Nonfusible Disconnecting Means:

   a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
   b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
   c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

4. MCP Disconnecting Means:

   a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

   b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.

d. N.C. alarm contact that operates only when MCP has tripped.

e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.

5. MCCB Disconnecting Means:

a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.

b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.

e. N.C. alarm contact that operates only when MCCB has tripped.

2.2 ENCLOSURES

A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 3R.
3. Other Wet or Damp Indoor Locations: Type 4.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.3 ACCESSORIES

A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.

a. Push Buttons: Unguarded types; maintained as indicated.
b. Pilot Lights: LED types; colors as indicated.
c. Selector Switches: Rotary type.

2. Meters: Panel type, 2-1/2-inch minimum size with 90- or 120-degree scale and plus or minus two percent accuracy. Where indicated, provide selector switches with an off position.

B. N.C. auxiliary contact(s).

C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

E. Breather and drain assemblies, to maintain interior pressure and release condensation in Type 4 and Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

F. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

G. Cover gaskets for Type 1 enclosures.

H. Terminals for connecting power factor correction capacitors to the line side of overload relays.

I. Spare control wiring terminal blocks, quantity as indicated[; unwired.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in each fusible-switch enclosed controller.

D. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."

E. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

F. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

G. Install power factor correction capacitors. Connect to the line side of overload relays. If connected to the load side of overload relays, adjust overload heater sizes to accommodate the reduced motor full-load currents.

H. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

3.4 FIELD QUALITY CONTROL

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Tests and Inspections:

1. Test and adjust controllers, components, and equipment.

2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.

3. Test continuity of each circuit.

4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).

5. Test each motor for proper phase rotation.

6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Enclosed controllers will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect before increasing settings.

D. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.

B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 262913

SECTION 26 43 13 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

B. Related Requirements:

1. Section 262416 "Panelboards" for factory-installed SPDs.

1.3 DEFINITIONS

A. Inominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Comply with UL 1449.

D. MCOV of the SPD shall be the nominal system voltage.

2.2 SERVICE ENTRANCE AND TRANSFER SWITCH SUPPRESSOR

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Eaton Corporation.
2. Schneider Electric Industries SAS.
3. Siemens Industry, Inc.

B. SPDs: Comply with UL 1449, Type 1.

C. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1

1. SPDs with the following features and accessories:

a. Integral disconnect switch.
b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
c. Indicator light display for protection status.
d. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
e. Surge counter.

D. Comply with UL 1283.

E. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 240kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

F. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.
2. Line to Ground: 1200 V for 480Y/277 V, 1200 V for 208Y/120 V.
3. Line to Line: 2000 V for 480Y/277 V, 1000 V for 208Y/120 V.

G. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V.
2. Line to Ground: 1000 V.
3. Line to Line: 1000 V.

H. SCCR: Equal or exceed 200 kA.

I. Inominal Rating: 20 kA.

2.3 PANEL SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Eaton Corporation.
2. Schneider Electric Industries SAS.

3. Siemens Industry, Inc.

B. SPDs: Comply with UL 1449, Type 1.

1. Include LED indicator lights for power and protection status.
2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

D. Comply with UL 1283.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V and 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.
2. Line to Ground: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.
3. Neutral to Ground: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.
4. Line to Line: 2000 V for 480Y/277 V, 1200 V for 208Y/120 V

F. Protection modes and UL 1449 VPR for 208/120-V, single-phase, three-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V.
2. Line to Ground: 700 V.
3. Neutral to Ground: 700 V.
4. Line to Line: 1200 V.

G. SCCR: Equal or exceed 100 kA.

H. Inominal Rating: 20 kA.

2.4 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

B. Outdoor Enclosures: NEMA 250, Type 3R.

2.5 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Class 2 Control Cables: Multiconductor cable with copper conductors not smaller than **No. 18** AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than **No. 14** AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Wiring:

1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
2. Controls: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 26 43 13

SECTION 26 51 00 – INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, and ballasts.
2. Exit signs.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CCT: Correlated color temperature.

C. CRI: Color-rendering index.

D. LER: Luminaire efficacy rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Ballast, including BF.
4. Energy-efficiency data.

B. Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

C. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

D. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

E. Field quality-control reports.

F. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

G. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Comply with NFPA 70.

C. When installed in the elevator hoistway/pit, atop the elevator cab, outdoors, or at other wet locations, the lighting fixtures shall be “NEMA 4”.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit Batteries: Three (3) years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining two (2) years.
2. Warranty Period for Emergency Fluorescent Ballast and Self-Powered Exit Sign Batteries: Three (3) years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining two (2) years.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents for all new fixtures.

1. Lamps: Furnish 10% of each type, but not less than one of each type.
2. Plastic Diffusers and Lenses: Furnish at least one of each type.
3. Ballasts: Furnish at least 10% of each type but not less than one of each type.
4. Globes and Guards: Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated on Drawings or approved equals. .

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

G. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

    a. "USE ONLY" and include specific lamp type.
    b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
    c. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
    d. CCT and CRI for all luminaires.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. General Requirements for Electronic Ballasts:

1. Comply with UL 935 and with ANSI C82.11.
2. Designed for type and quantity of lamps served.
3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
4. Sound Rating: Class A
5. Total Harmonic Distortion Rating: Less than 20 percent.
6. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

B. Luminaires controlled by occupancy sensors shall have programmed-start ballasts.

C. Electronic Programmed-Start Ballasts for T8 Lamps: Comply with ANSI C82.11 and the following:

1. Automatic lamp starting after lamp replacement.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: Class A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher unless otherwise indicated.
9. Power Factor: 0.95 or higher.

10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

2.1 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs: As specified on Drawings or approved equal..

2.2 FLUORESCENT LAMPS

A. T8 rapid-start lamps, rated 32 W minimum, nominal length of 48 inches, 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life 20,000 hours unless otherwise indicated.

B. Compact Fluorescent Lamps: 4-Pin, CRI 80 (minimum), color temperature 3500 K, average rated life of 10,000 hours at three hours operation per start, and suitable for use with dimming ballasts unless otherwise indicated.

2.1 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.

F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

E. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.

G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Verify that self-luminous exit signs are installed according to their listing and the requirements in NFPA 101.

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.4 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

END OF SECTION 26 51 00

SECTION 26 56 00 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior luminaires with lamps and ballasts.
2. Luminaire-mounted photoelectric relays.

B. Related Sections:

1. Section 265100 "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. HID: High-intensity discharge.

D. LER: Luminaire efficacy rating.

E. Luminaire: Complete lighting fixture, including ballast housing if provided.

F. Pole: Luminaire support structure, including tower used for large area illumination.

G. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4-M.

B. Live Load: Single load of 500 lbf (2224 N), distributed as stated in AASHTO LTS-4-M.

C. Ice Load: Load of 3 lbf/sq. ft. (145 Pa), applied as stated in AASHTO LTS-4-M Ice Load Map.

1.5 ACTION SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.

    a. Testing Agency Certified Data: For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
    b. Manufacturer Certified Data: Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

6. Photoelectric relays.
7. Ballasts, including energy-efficiency data.
8. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.
9. Materials, dimensions, and finishes of poles.
10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
11. Anchor bolts for poles.
12. Manufactured pole foundations.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
3. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.
4. Wiring Diagrams: For power, signal, and control wiring.

C. Samples: For products designated for sample submission in the Exterior Lighting Device Schedule. Each Sample shall include lamps and ballasts.

1.6 INFORMATIONAL SUBMITTALS

A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations by a professional engineer.

B. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 10% of each type and rating installed. Furnish at least one of each type.
2. Glass and Plastic Lenses, Covers, and Other Optical Parts: One for every 10 of each type and rating installed. Furnish at least one of each type.
3. Ballasts: One for every 10 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: One for every 10 of each type and rating installed. Furnish at least one of each type.

1.9 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with IEEE C2, "National Electrical Safety Code."

E. Comply with NFPA 70.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant-treated skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on fiberglass and laminated wood poles until right before pole installation. Handle poles with web fabric straps.

D. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Two years from date of Substantial Completion.
2. Warranty Period for Metal Corrosion: Two years from date of Substantial Completion.
3. Warranty Period for Color Retention: Two years from date of Substantial Completion.
4. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

1. LER Tests Incandescent Fixtures: Where LER is specified, test according to NEMA LE 5A.
2. LER Tests Fluorescent Fixtures: Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

3. LER Tests HID Fixtures: Where LER is specified, test according to NEMA LE 5B.

B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

M. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."

2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

    a. Color: As selected by Architect from manufacturer's full range.

N. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

    a. Color: Medium bronze.

O. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

    a. "USES ONLY" and include specific lamp type.
    b. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
    c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
    d. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.
    e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
    f. CCT and CRI for all luminaires.

2.3 FLUORESCENT BALLASTS AND LAMPS

A. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F (Minus 17 Deg C) and Higher: Electronic type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.
2. Temperatures Minus 20 Deg F (Minus 29 Deg C) and Higher: Electromagnetic type designed for use with indicated lamp types.

B. Ballast Characteristics:

1. Power Factor: 90 percent, minimum.
2. Sound Rating: Class A.
3. Total Harmonic Distortion Rating: Less than 10 percent.
4. Electromagnetic Ballasts: Comply with ANSI C82.1, energy-saving, high power factor, Class P, automatic-reset thermal protection.
5. Case Temperature for Compact Lamp Ballasts: 65 deg C, maximum.
6. Transient-Voltage Protection: Comply with IEEE C62.41.1 and IEEE C62.41.2, Category A or better.

C. Low-Temperature Lamp Capability: Rated for reliable starting and operation with ballast provided at temperatures 0 deg F (minus 18 deg C) and higher.

2.4 BALLASTS FOR HID LAMPS

A. Comply with ANSI C82.4 and UL 1029 and capable of open-circuit operation without reduction of average lamp life. Include the following features unless otherwise indicated:

1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C).
3. Normal Ambient Operating Temperature: 104 deg F (40 deg C).
4. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.

B. Auxiliary, Instant-On, Quartz System: Factory-installed feature automatically switches quartz lamp on when fixture is initially energized and when momentary power outages occur. System automatically turns quartz lamp off when HID lamp reaches approximately 60 percent of light output.

C. High-Pressure Sodium Ballasts: Electromagnetic type with solid-state igniter/starter and capable of open-circuit operation without reduction of average lamp life. Igniter/starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.

1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.

   a. Restrike Range: 105- to 130-V ac.
   b. Maximum Voltage: 250-V peak or 150-V ac rms.

2. Minimum Starting Temperature: Minus 40 deg F (Minus 40 deg C).

2.5 HID LAMPS

A. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), CCT color temperature 1900 K, and average rated life of 24,000 hours, minimum.

1. Dual-Arc Tube Lamp: Arranged so only one of two arc tubes is lighted at one time and, when power is restored after an outage, the cooler arc tube, with lower internal pressure, lights instantly, providing an immediate 8 to 15 percent of normal light output.

B. Metal-Halide Lamps: ANSI C78.43, with minimum CRI 65, and CCT color temperature 4000 K.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

3.2 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.3 GROUNDING

A. Ground metal poles and support structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

B. Ground nonmetallic poles and support structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole.
2. Install grounding conductor and conductor protector.
3. Ground metallic components of pole accessories and foundations.

3.4 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):

a. IESNA LM-5, "Photometric Measurements of Area and Sports Lighting Installations."
b. IESNA LM-50, "Photometric Measurements of Roadway Lighting Installations."
c. IESNA LM-52, "Photometric Measurements of Roadway Sign Installations."
d. IESNA LM-64, "Photometric Measurements of Parking Areas."
e. IESNA LM-72, "Directional Positioning of Photometric Data."

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaire lowering devices.

END OF SECTION 26 56 00

SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Grounding/Earthing and bonding for Low Voltage systems such as telecommunications and audiovisual systems.
2. Telecommunications Grounding Busbar (TGB)
3. Telecommunications Main Grounding Busbar (TMGB)
4. Telecommunications Bonding Backbone (TBB)
5. Rack Grounding/Earthing and Bonding
6. Pathways.

B. Related Sections:

1. Division 26 Section *Grounding and Bonding* for building systems with which to interface with Work of this Section.

1.2 DEFINITIONS

A. AFC: Above Finished Ceiling

B. BICSI: Building Industry Consulting Service International.

C. Bonding: Permanent joining of metallic parts to form an electrically conductive path to ensure electrical continuity and capacity to safely conduct current.

D. Common Bonding Network (CBN) – The principal means for affecting bonding and earthing inside a building.

E. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

F. EMI: Electromagnetic interference.

G. Ground/Earth – A conducting connection, whether intentional or incidental, by which an electric circuit or equipment is connected to ground, or to some conducting body of relatively large extent that serves in place of the ground.

H. HC: Horizontal Cross Connect

I. IDC: Insulation displacement connector.

J. LAN: Local Area Network.

K. MC: Main Cross-connect

L. NEBS: Network Equipment Building System.

1. NEBS Level 3: Equipment complies with strict specifications for fire suppression, thermal margin testing, vibration resistance including seismic, airflow patterns, acoustic limits, failover and partial operational requirements such as chassis fan failures, failure severity levels, RF emissions and tolerances, and testing/certification requirements.

M. NEC: National Electric Code

N. RCDD: Registered Communications Distribution Designer.

O. TR: Telecommunications Room

P. UTP: Unshielded twisted pair.

1.3 SYSTEM DESCRIPTION

A. Provide a complete and functioning Telecommunications grounding/earthing system inclusive of all hardware, software and training to meet or exceed the performance features outlined in this document.

B. Purpose: Telecommunications grounding/earthing system creates a low impedance path to earth ground to prevent damage to equipment and disruption in service due to electrical surges and transient voltages.

C. Grounding/earthing system comply with following:

1. NEC and local electrical codes
2. ANSI/TIA-942 and J-STD-607-A.
3. IEEE 1100

D. Telecommunications Grounding Busbar (TGB): Ground/earth each telecommunications space to the Telecommunications Main Grounding Busbar (TMGB) located at the service entrance.

1.1 SUBMITTALS

E. Comply with Division 01330 Section *Submittal Procedures*.

F. Submittal data is to be submitted in a three ring binder, a continuous spiral binder, or plastic binding that allows the booklet to lie flat while open. Each booklet shall contain the below in the following order:

1. Cover Sheet.

a. Include name of supplying contractor and project name.

2. Detailed Bill of Materials.

a. Include a listing of: component quantities, equipment manufacturer, model number, and description of each component being supplied, and the specification paragraph or drawing sheet that corresponds to the product. Failure to provide this information will result in the rejection of submittals.

3. Product Data.

a. Include a catalog sheet per product of equipment listed in the Detailed Bill of Materials, in the exact order as the Detailed Bill of Materials. Each catalog sheet shall describe mechanical, electrical and functional equipment specifications. The catalog sheet must also include a image of the product. Photocopy duplications of the manufacturer's original equipment catalog sheets will be allowed as long as they provide adequate clarity of both the printed word and graphics/pictures. If more than one product is shown on the catalog sheet the intended product must be denoted by either an arrow or highlight.

G. Shop Drawings

1. Wiring diagram to show grounding schematics, including the following: Busbars and bonding backbone. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
2. Show the relationship of TR's, the pathway between them, and cable connectivity to be installed.
3. Drawings should be at project standard scale clearly legible.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements, grounding/earthing and bonding systems:

1. TIA/EIA

a. TIA-942 Telecommunications Infrastructure Standard for Data Centers
b. J-STD-607-A Commercial Building Grounding/Bonding Requirements
c. TIA/EIA-606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

2. IEEE

a. Std 1100 IEEE Recommend Practice for Powering and Grounding Electronic Equipment (IEEE Emerald Book)

3. Telcordia:

a. NEBS 3 as defined for RBOC-CO compliance.

4. NFPA

a. NFPA-70 National Electric Code (NEC)

5. ECA-BICSI

a. ECA-BICSI-607-2011 Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings

B. Testing Procedures:

1. NEBS GR-63-CORE: Network Equipment-Building System Requirements: Physical Protection.
2. NEBS GR-1089-CORE: Electromagnetic Compatibility and Electrical Safety -- Generic Criteria for Network Telecommunications Equipment

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers, Grounding/Earthing Systems:

1. Panduit
2. Chatsworth
3. Harger
4. Burndy
5. Ortronics/Legrand
6. Erico

B. Acceptable Manufacturers, Telecommunications Grounding Busbar:

1. Panduit
2. Chatsworth
3. Harger
4. Burndy
5. Ortronics/Legrand
6. Erico

C. Acceptable Manufacturers, Rack Grounding Kits:

1. Panduit
2. Chatsworth
3. Harger
4. Burndy
5. Ortronics/Legrand
6. Erico

2.2 GROUNDING/EARTHING AND BONDING

A. General:

1. Conductors: Provide copper grounding/earthing conductors.

2. Lugs, grounding strips, and busbars: UL Listed. Fabricate with premium quality tin-plated electrolytic copper, providing low electrical resistance while inhibiting corrosion. -Provide antioxidant for field- bonding connections.
3. Lugs: NEBS Level 3. Provide two-hole lugs with irreversible compression and inspection windows, certified for use in non-corrosive environments so that connections may be inspected for full conductor insertion.
4. Die index numbers: Embossed on compression connections to allow crimp inspection.
5. Cable assemblies: UL Listed and CSA Certified.

    a. Cables: Green or green/yellow.
    b. Jackets: UL Listed, VW-1 flame rated.

B. Telecommunications Bonding Backbone (TBB): At cable used to ground/earth TGB; comply with J-STD-607-A guidelines and provide gauge not lighter than the following:

Sizing of the TBB	
TBB Length in Linear meters (feet)	TBB Size (AWG)
Less than 4 (13)	6
4-6 (14-20)	4
6-8 (21-26)	3
8-10 (27-33)	2
10-13 (34-41)	1
13-16 (42-52)	1/0
16-20 (53-66)	2/0
Greater than 20 (66)	3/0

C. Grounding Cable, Typical: For applications other than TBB, provide gauge not lighter than the following:

Cable Sizes for Other Grounding/Earthing Applications	
Purpose	Copper Code Cable Size
Aisle grounds (overhead or under floor) of the common bonding network	#2 AWG or larger (1/0 preferred)
Bonding conductor to each PDU or panel board serving the room.	Size per NEC 250.122 & manufacturer recommendations
Bonding conductor to HVAC equipment	6 AWG
Building columns	4 AWG
Cable ladders and trays	6 AWG
Conduit, water pipe, duct	6 AWG

2.3 COMPONENTS, KITS AND HARDWARE

A. Provide BICSI/J-STD-607-A telecommunications grounding busbars for the TMGB. Locate TMGB at AC service entrance.

B. Provide BICSI/J-STD-607-A telecommunications grounding busbars for the TGB at typical telecommunications/equipment spaces throughout the building.

C. Provide compression type two hole lugs for connecting conductors to TMGB and TGB.

PART 3 - EXECUTION

3.1 ROUTING TBB AND TGB

A. Route the TBB to each TGB in as straight a path as possible. The TBB should be installed as a continuous conductor, avoiding splices where possible. When more than one TBB is used, bond them together using the TGBs on the top floor and every third floor in between with a conductor known as a Grounding Equalizer (GE). Use the J-STD-607-A guidelines for sizing of the TBB when sizing the GE (shown in the table above).

B. Avoid routing grounding/earthing conductors in metal conduits. If the grounding/earthing conductor must be routed through a metal conduit, bond each end of the conduit to the grounding/earthing conductor. Use grounding clamps to bond to the conduit and #6 AWG copper conductor to connect the grounding clamp to the GB.

3.2 RACK GROUNDING/EARTHING

A. Bonding Equipment and Racks: Comply with ANSI/TIA-942.

B. To provide electrical continuity between rack elements, use paint piercing grounding washers where rack sections bolt together, on both sides, under the head of the bolt, and between the nut and rack.

C. Utilize full-length rack ground strips attached to the rear of the side rail with thread-forming screws provided to ensure metal-to-metal contact.

D. Mount an electrostatic discharge (ESD) port kit, directly to the rack grounding strip on the back of the rack at approximately 48 inches from the floor. Mount a second electrostatic discharge (ESD) port kit directly to the vertical mounting rail of the rack in the front at approximately the same height. Use the thread-forming screws provided to form a bond to the rack.

E. When the equipment manufacturer provides a location for mounting a grounding connection, that connection shall be utilized. Use the appropriate jumper for the equipment being installed and the thread-forming screws provided in the kit.

F. Do not bond racks or cabinets serially.

G. Bond patch panels to racks using bonding screws.

3.3 TESTING

A. Perform continuity testing measurements of the grounding system with resistance to not exceed 0.1 ohm between:

1. The TMGB and the nearest grounding electrode.
2. Each TGB and the nearest grounding electrode.
3. Each TGB and pathway(s), rack(s), cabinet(s), and applicable equipment.

3.4 GROUNDING SYSTEM

A. Communications grounding system: Comply with ANSI/TIA-942 and J-STD-607-A.

B. Connection to Building ground/earth: Ensure connection is made by a licensed, electrical Installer, including installation and termination of the main bonding conductor to the building service entrance ground.

C. Bond TMGB to building steel; ground/earth to electrical service ground specified in Section 27 05 26. Comply with BICSI TDM Manual and J-STD-607-A guidelines.

END OF SECTION 27 05 26

SECTION 27 05 28.36 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The work under this section shall consist of the furnishings of all necessary material, labor and associated services required to complete the installation of the wire runway cable management system as shown on the “TA” series drawings.

B. A wire runway cable management system (herein referred to as Cable Tray) shall be defined as a welded steel wire cable conveyance system consisting of flexible linear or module sections designed to support, but are not limited to fiber optic and voice/data telecommunication cables. Where field formed bends are required, the linear sections shall be hand bendable in any direction along any plane without tools, cutting, clipping or modifications of the tray in order to complete the bend. Tray shall be constructed from cold rolled steel in accordance with ASTM A510 and shall be zinc plated in accordance with ASTM B633 SC2. Tray shall also be designed in such a way as to allow cables to enter or exit the tray in any direction at any point along the length of the tray while also allowing cables to be added or removed without modification or manipulation of the tray system, including hanging hardware.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

A. Related Sections:

1. Division 27 00 00 Telecommunications Cabling Systems for voice and data cabling associated with system panels and devices.

B. Bidding Requirements:

1. Submit complete detailed proposals with line item cost representation for components and associated installation labor. Lump sum bids will not be accepted.
2. Include as part of the bid response the following items:
3. Installation schedule with proposed manpower assignments.
4. Resumes for project manager and lead technician for this project.
5. Review associated “E”, “TA” Series electrical, audiovisual/ telecommunications infrastructure drawings to verify that necessary conduit and w/ floor boxes will be provided. Understand and coordinate shared infrastructure locations for AV and voice/ data outlets. No additional infrastructure to support the telecommunications cabling

systems (Inside plant/ outside plant) will be provided. Any discrepancies with the identified infrastructure to support these systems should be questioned in the form of a request for information (RFI) during the bidding process. Be responsible for any additional infrastructure requirements after receipt of contract for this project. No wiremold or surface mounted raceways shall be approved on this project.

1.4 REFERENCES

A. IEC 61537 (2001) – Cable Tray Systems and Cable Ladder Systems for Cable Management

B. NEMA VE 1-2002/CSA C22.2 No. 126.1-02 – Metal Cable Tray Systems

C. ANSI/NFPA 70 (2005) – National Electrical Code (NEC)

D. TIA 569-A (1998) and addendums – Commercial Building Standard for Telecommunications Pathways & Spaces

E. ASTM A 510 - Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel

F. ASTM A 380 – Specification for Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems

G. ASTM B 633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel

H. ASTM A 123 – Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

I. ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality

J. Norm NF/A 91-131 for Galvanized Steel

K. Norm NF/EN 12-329 for Electrozinc Coating

L. Norm NF/EN/ISO 14-61 for Hot-Dipped Galvanized Steel

M. Norm NF 10-088-2 for Stainless Steel

1.5 SYSTEM DESCRIPTION

A. This section outlines the performance for the noted cable tray support systems, as indicated on the “TA” Series drawings. An existing cable support / cable tray system located in the existing Office of the President building shall be salvaged and re-used. New cable tray systems shall be installed in the areas of new construction, and shall conform to the model, type, and dimensions of the existing cable tray system. Confirm conformance of new cable tray systems to existing cable tray systems prior to installation. Cable tray systems shall be installed above finished

ceiling in the common area hallways that are located on all floors of the building. The common area cable tray is intended to support telecommunications cabling from any of the station cable wall/floor outlet locations on any floor. Each station cable wall/floor outlet shall have a configuration of conduit pipe run to the tray system to support the aforementioned station cabling.

1.6 DESIGN REQUIREMENTS

A. Maximum Deflection between Supports: L/240.

1.7 SUBMITTALS

A. Comply with requirements of Section 01 33 00 - Submittal Procedures.

B. Submittal data is to be submitted in a three ring binder, a continuous spiral binder, or plastic binding that allows the booklet to lie flat while open. Each booklet shall contain the below in the following order:

1. Cover Sheet.

   a. Include name of supplying contractor and project name.

2. Detailed Bill of Materials.

   a. Include a listing of: component quantities, equipment manufacturer, model number, and description of each component being supplied, and the specification paragraph or drawing sheet that corresponds to the product. Failure to provide this information will result in the rejection of submittals.

3. Product Data.

   a. Include a catalog sheet per product of equipment listed in the Detailed Bill of Materials, in the exact order as the Detailed Bill of Materials. Each catalog sheet shall describe mechanical, electrical and functional equipment specifications. The catalog sheet must also include a image of the product. Photocopy duplications of the manufacturer’s original equipment catalog sheets will be allowed as long as they provide adequate clarity of both the printed word and graphics/pictures. If more than one product is shown on the catalog sheet the intended product must be denoted by either an arrow or highlight.

4. Prequalification Certificate.

   a. Copy of the installing technician(s) certificate of completion from the manufacturer’s training school for the equipment being provided.

5. Manufacturer Qualifications

a. Submit manufacturer's certification indicating ISO 9002 quality certified.

6. Design Calculations

a. Verify loading capacities for supports.

7. Submit Factory-certified test reports of specified products, complying with IEC 61537, NEC, and NEMA VE 1/CSA C22.2 No. 126.1.

C. Shop Drawings are to be submitted on project standard full size and bound. Each shop drawing set is to include the below in the following order:

1. Title Sheet.

a. Containing, at a minimum, a list of all drawings in the set and a symbols legend defining each symbol used in the package.

D. Coordination Drawings

1. Include floor plans and sections drawn to scale. Include scaled cable tray layout and relationships between components and adjacent structural and mechanical elements. Data presented on these drawings are as accurate as preliminary surveys and planning can determine. Field verification of all dimensions, routing, etc., is directed.

E. Cable Tray Drawings

1. Submit drawing indicating materials, finish, dimensions, and accessories. Show layout, support, and installation details.

1.8 QUALITY ASSURANCE

A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.

B. Manufacturer Qualifications: ISO 9002 quality certified.

C. Comply with NFPA 70. National Electrical Code, Article 392: Cable Trays; provide UL Classification and labels.

D. Provide ETL test documentation showing cable compression/deformation testing.

1.9 COORDINATION

A. Coordinate layout and installation of cable tray with other installations.

1. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Architect.

B. Storage and Handling: Avoid breakage, denting and scoring finishes. Damaged products will not be installed. Store cable trays and accessories in original cartons and in clean dry space; protect from weather and construction traffic. Wet materials will be unpacked and dried before storage. Protect materials and finishes during handling and installation to prevent damage

C. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Cable Management Solutions, 291 Skip Lane, Bay Shore, NY 11706, or approved equal shall manufacture the cable management system. Other manufacturers can only be considered equal if, in the opinion and written approval of Delaware Technical Community College, they meet all the performance and design standards specified herein.

2.2 GENERAL

A. Tray shall have a single spine wire

B. Linear single spine tray shall be hand bendable in any direction along any plane, and will not require tools, cutting, clipping or modifications to the structure of the tray to create the bend.

C. Tray shall be field formed as needed.

D. UL Compliance: Provide products that are UL-Listed

E. Tray shall be designed in such a way as to be secured to the following, but not limited to: wall, rod, floor; every four (4) feet via built-in integrated mounting rings or double rail.

F. Splicing of trays shall be accomplished by using a single manufacturer supplied UL classified connector bolt or splice plate.

G. The terminal ends of the tray shall be considered jumpers and when properly joined to another tray shall via an approved connection bolt provide a proper-grounded link between trays, as per NEC article 250.

2.3 CABLE TRAY SYSTEM

A. Description: CMS/Snake Tray Series 201.

1. Tray shall be hand bendable along the center rod in all planes without tools. No additional parts are required to complete the directional change.
2. Available in both single and double sided trays.

3. Tray shall have a single wire spine located above the cable path allowing the tray to self-level itself as it is loaded, and allow cables to be installed or removed from either the top or side without removing any component.
4. Tray shall be designed in such a way as to be suspended every four (4) feet via built-in integrated horizontal mounting rings spaced every four (4) inches along the center spine, without additional brackets.
5. Tray shall be designed in such a way as to allow the tray to be suspended from above the cable pathway via minimum 3/8-inch diameter rod, attached to a wall or ceiling.

B. UL Classification: All sections of cable tray shall be UL Listed.

C. Material: Stainless Steel in accordance with ASTM A580/A580M-06 Standard Specification for Stainless Steel Wire.

D. Finishes:

1. Electrodeposited Clear Zinc Plated in accordance with ASTM B633 type III SC1.
2. Electrodeposited Zinc Dichromate Plated in accordance with ASTM A633 type II SC2.
3. Electrodeposited Yellow Zinc Dichromate plated in accordance with ASTM A633 type II SC2.
4. Color coated surface treatment over Electrodeposited Zinc Plating. Contact CMS for color information.

E. Nominal Dimensions:

1. All new installed cable tray systems shall conform to the dimensions (depth and width) of the existing cable tray system.

2.4 ACCESSORIES

A. To include, but not limited to mounting brackets, turnout components and support rods. Components shall be made from high strength steel wires and/or sheet formed, welded and plated as required as per applicable ASTM standards. Special accessories shall be furnished as required to install the tray system.

B. Intersections:

1. Part Number CM 0303H, Single Sided Tray Intersection, 5 1/2” wide x 5 1/2” long.
2. Part Number CM 201Y, Single Sided Tray “Y” Intersection, 5” wide x 6” long.
3. Part Number CM 201/501T, Single Sided Tray/Wall Snake Transition, 5 1/4” wide x 5 1/4” long.
4. Part Number CM 201-ES, Wall End Plate, 3 1/2” wide x 3 1/2” long.
5. Part Number CM 425D/5D, Double Sided Tray Intersection, 12” wide x 12” long.
6. Part Number CM 425/425D, Single Sided Tray/Double Sided Tray Intersection, 7 1/2” wide x 20” long.
7. Part Number CB-10, Universal Connector Bolt, Bolted and Grounded Connection as per ANSI/NFPA 70/250 - National Electric Code – Ground and Bonding.
8. Part Number CB-12, Universal Inline Connector Bolt

9. Part Number WBN-201, Wall Mount Bracket for single sided trays, 4” wide x 5” long
10. Part Number WBN-201D, Wall Mount Bracket for 4 ¼” Double Tray, 4” wide x 5” long
11. Part Number WBN-2015D, Wall Mount Bracket for 5” Double Tray, 5” wide x 6” long
12. Part Number RBN-201, Rack Mount Bracket for single sided trays, 4” wide x 5” long
13. Part Number RBN-201D, Rack Mount Bracket for double sided trays, 4” wide x 5” long
14. Part Number CBN-201, Cabinet Mount Bracket for single sided trays, 4” wide x 5” long
15. Part Number CBN-201D, Cabinet Mount Bracket for double sided trays, 4” wide x 5” long
16. Part Number ST-201, Under Floor Mount Bracket for single sided trays, 4” wide x 5” long
17. Part Number ST-201D, Under Floor Mount Bracket for 4 ¼” Double Tray, 4” wide x 5” long
18. Part Number ST-2015D, Under Floor Mount Bracket for 5” Double Tray, 5” wide x 6” long

C. Cable Drop-Out:

1. Part Number TO-2, 2” Wide cable drop out, 2” wide x 9” long
2. Part Number TO-3, 3” Wide cable drop out, 3” wide x 9” long
3. Part Number TO-425, 4 1/4” Wide cable drop out, 4 1/4” wide x 9” long
4. Part Number TO-5, 5” Wide cable drop out, 5” wide x 9” long
5. Part Number TO-6, 6” Wide cable drop out, 6” wide x 9” long

2.5 FIRE STOP CABLE PASS-THRU SLEEVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are limited to, the following:

1. Basis of design: Specified Technologies Inc.
2. Approved equal by:

   a. 3M Corporation.
   b. Hilti Corporation.
   c. Wiremold- Legrand Corporation.

B. Fire Rated Cable Pathways: STI EZ-PATH ™ Brand device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:

1. Specified Technologies Inc. (STI) EZ-PATH Series 44 Fire Rated Pathway
2. Specified Technologies Inc. (STI) EZ-PATH Series 33 Fire Rated Pathway

PART 3 - EXECUTION

3.1 EXAMINATION

A. Exam areas to receive cable management system. Notify the Architect of conditions that would adversely affect the installation or subsequent utilization of the system. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install cable tray level and plumb according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.

B. Install cable management system at locations indicated on the drawings and in accordance with manufacturer's instructions. Install the cable tray system directly above the racks positioned within the space to allow for ease in cable management to and from the racks. Provide firestopping at penetration into/ out of Telecommunication rooms..

C. Load Span Criteria: Install and support cable management system in accordance with span load criteria of L/240.

D. Install cable management system using hardware, support components, and accessories furnished by manufacturer.

E. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed 90 feet.

F. Ground cable tray according to manufacturer’s written instructions.

G. The cable tray and ceiling installation shall allow for re-entry to accommodate additional cable to be pulled from all occupied spaces to their respective IDF locations on each floor.

H. Certified Installers: Cable tray installers must be certified by the manufacturer.

3.3 FIRESTOPPING

A. Firestopping In Telecommunications Room At Cable Tray Entrance

1. Install EZ Path Series 44 as shown on contract drawings.

B. Firestopping where cable tray passes through a rated wall assembly.

1. Install quantity of EZ Path series 33 or series 44 to 100% fill ratio of the size of cable tray at entrance to opening.

C. General: Install through-penetration firestop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.

D. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of firestopping products.

END OF SECTION 27 05 28.36

SECTION 27 05 28.49 – TELECOMMUNICATIONS CABLING SYSTEMS FLOORBOX

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Telecommunications Cabling Floorbox.

B. Related Sections include the following:

1. Division 09 Sections for Floor Coverings.
2. Division 27 Electrical Section Telecommunications Systems, wiring, connections, and installation of associated conduit infrastructure.

1.2 PERFORMANCE REQUIREMENTS

A. General: Floor boxes provide interface between power and telecommunication cabling in concrete floors and decks at workstations or at activation locations requiring power or communication device outlets.

1. ADA Compliance: Flush-mounted floor device outlets shall not create tripping hazard.

B. Floor Mounted Connector Assembly: Watertight, rubber cable pass thru gasketed door and cover assembly, utilizing basket and connector mounting panel inserts.

C. Labeling: Floor boxes shall bear the “cULus mark” issued by UL for units complying with both US and Canadian Standards.

D. Standards: Comply with the following:

1. UL 514A and Canadian Standard C22.2.
2. National Electrical Code.

1.3 SUBMITTALS

A. Comply with Section 01 33 00 Section *Submittal Procedures*.

B. Submittal data is to be submitted in a three ring binder, a continuous spiral binder, or plastic binding that allows the booklet to lie flat while open. Each booklet shall contain the below in the following order:

1. Cover Sheet.

a. Include name of supplying contractor and project name.

2. Product Data.

a. Include a catalog sheet per product. Each catalog sheet shall describe mechanical, electrical and functional equipment specifications. The catalog sheet must also include a image of the product. Photocopy duplications of the manufacturer's original equipment catalog sheets will be allowed as long as they provide adequate clarity of both the printed word and graphics/pictures. If more than one product is shown on the catalog sheet the intended product must be denoted by either an arrow or highlight.

3. Informational Submittals.

a. Manufacturer's installation instructions.

C. Shop Drawings are to be submitted on project standard full size and bound. Each shop drawing set is to include the below in the following order:

1. Detailed riser drawing indicating conduit runs and associated (box knockout) cables within.
2. Floor plans showing floorbox locations based on column grid lines.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Telecommunications Cabling Floorbox:

1. Basis for Design: Resource Series RFB4-4DB, Wiremold
2. Other acceptable manufacturers:

a. FSR (800) 332-3771
b. Mystery Electronics
c. Ace Backstage

2.2 MATERIALS

A. Door and Cover: Not lighter than 11 gauge steel with integral, self trimming carpet trim ring. Mount trim ring flush with floor covering. Secure with security socket head screws.

1. Finish: Satin black coating.
2. Trim: Door, cover, and integral trim ring shall have radiused corners.

B. Boxes: One or two-gang configurations.

1. Shape: Rectangular.

2. Adjustability: Able to adjust units before and after concrete placement.
3. Modular Design: Provide removable barrier between individual compartments to enable increased capacity after installation.
4. Materials:

    a. Elevated Decks: Stamped-steel.
    b. Slab-on-grade: Cast-iron.

C. Box interior and exterior shall be painted. Boxes shall be available in one and two-gang configurations. All cast-iron versions shall provide 1 3/4" (44mm) of pre-pour adjustment and 1/2" (12.7mm) of post-pour adjustment. Minimum depth of boxes shall be 3 7/16" (87mm).

D. Each box shall contain four locations to accommodate leveling for pre-concrete pour adjustment. Each box shall provide four leveling screws for this pre-pour adjustment.

E. Overall box dimensions shall be as follows:

1. Four-gang: 8-3/16 inches (132mm) wide by 8 - ½ inch (216mm) long.

F. Provide at least 48 cubic inches (787ml) of Device Wiring Chamber volume.

1. Provide at least four 1¼” (45mm) threaded conduit openings to feed cabling to the floor box.

G. Provide pull strings in each conduit at floor box location. Coordinate conduit to box knockout location with telecommunication cabling and audiovisual systems requirements. Terminate a duplex power receptacle, up to eight (8) CAT. 6 type data outlets, along with a waterproof cable pass-through.

H. The floor box manufacturer shall have available a complete line of workstation connectivity outlets and modular inserts, and Activate Connectivity Modular Inserts for UTP (including Cat 6), Fiber Optic, Coaxial, and other cabling types with faceplates and bezels to facilitate mounting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The minimum concrete pour depth shall 3-1/2 inches (89mm).

B. With Installer present, verify that manufacturer’s requirements for floor opening and infrastructure conditions have been satisfactorily met. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Arrange for jobsite approval of the equipment prior to commencing installation.

B. Verify exact locations of floorbox installation.

3.3 INSTALLATION

A. Install equipment in compliance with approved shop drawings and manufacturer's installation instructions.

B. Install in position and relationship to adjoining work indicated, securely anchored to supporting structure, sealed and finished, and in a manner, which produces a level box with square, plumb, and straight edges.

C. Telecommunications Cabling Floorbox shall have a total of three separate EC with pull string at each box as follows:

1. One 3/4-inch EC from box to circuit panel. (Duplex AC Power)
2. Two 1-1/4 inch EC from box to telecomm cable tray A.F.C (CAT. 6 data cables)

D. Coordinate installation with floor covering to finish each floor box. Install floor covering with oversized cable management pop-up pass-thru in top, matching surrounding floor covering in cover insert.

3.4 ADJUSTING

A. Adjust door and cover for proper operation.

3.5 PROTECTION

A. Protect installed equipment in original undamaged condition until Substantial Completion. Remove and provide new components or units that cannot be repaired to the satisfaction of the Architect.

END OF SECTION 27 05 28.49

SECTION 27 10 00 - TELECOMMUNICATIONS STRUCTURED CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. UTP cabling.
2. Cable connecting hardware, patch panels, and cross-connects.
3. Telecommunications outlet/connectors.
4. Optical fiber cabling.
5. Cable management system.
6. Cabling identification products.
7. Backboards.
8. Telecommunications equipment racks and cabinets.
9. Telecommunications service entrance pathways.
10. Grounding.
11. Pathways.
12. Telecommunications mounting elements.

B. Related Sections:

1. Division 27 05 26 “Grounding and Bonding for Communications Systems “for voice and data cabling associated with system panels and devices.
2. Division 27 05 28.36 “Cable Trays for Communications Systems" for voice and data cabling associated with system panels and devices.

C. Bidding Requirements:

1. Bidder shall submit complete detailed proposals with line item cost representation for components and associated installation labor. Lump sum bids will not be accepted.
2. Bidders shall include as part of the bid response the following items:

    a. Installation schedule with proposed manpower assignments.
    b. Resumes for project manager and lead technician for this project.
    c. BICSI RCDD certificate and registration number.

3. Bidders shall review associated electrical, telecommunications infrastructure drawings to verify that necessary conduit and floor boxes will be provided by others. Bidders shall

understand and coordinate shared infrastructure locations for telecommunications outlets. The Owner will provide no additional infrastructure to support the telecommunications cabling systems Inside Plant (ISP) and Outside Plant (OSP). Any discrepancies with the identified infrastructure to support these systems should be questioned in the form of a request for information (RFI) during the bidding process. Be responsible for any additional infrastructure requirements after receipt of contract for this project. No wiremold or surface mounted raceways shall be approved on this project.

4. Unspecified Equipment and Material: Any item of equipment or material not specifically addressed on the drawings or in this document and required to provide complete and functional Structured Cabling System shall be provided in a level of quality consistent with other specified items.

1.3 DEFINITIONS

A. AFC: Above Finished Ceiling Riser:

B. BICSI: Building Industry Consulting Service International.

C. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.

D. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

E. EF: Entrance Facility

F. EMI: Electromagnetic interference.

G. HC: Horizontal Cross Connect

H. IDC: Insulation displacement connector.

I. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

J. LAN: Local Area Network.

K. MC: Main Cross-connect

L. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.

M. NRTL: Nationally Recognized Testing Laboratory

N. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

O. RCDD: Registered Communications Distribution Designer.

P. TR: Telecommunications Room

1.4 SYSTEM DESCRIPTION

A. Provide a complete and functioning Structured Cabling System inclusive of all hardware, software and training to meet or exceed the performance features outlined in this document.

B. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
2. Horizontal cabling shall contain no more that one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
3. Bridged taps and splices shall not be installed in the horizontal cabling.
4. Splitters shall not be installed as part of the optical fiber cabling.

C. A work area is approximately 100 sq. ft., and includes the components that extend from the telecommunications outlet/connectors to the station equipment.

D. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect.

E. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

F. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

G. Communications equipment room shall provide the space to house the equipment for the backbone and horizontal cabling.

1.5 PERFORMANCE REQUIREMENTS:

A. General Performance: The cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 SUBMITTALS

A. Comply with requirements of Section 01 33 00 - Submittal Procedures.

B. Submittal data is to be submitted in a three ring binder, a continuous spiral binder, or plastic binding that allows the booklet to lie flat while open. Each booklet shall contain the below in the following order:

1. Cover Sheet.

   a. Include name of supplying contractor and project name.

2. Detailed Bill of Materials.

   a. Include a listing of: component quantities, equipment manufacturer, model number, and description of each component being supplied, and the specification paragraph or drawing sheet that corresponds to the product. Failure to provide this information will result in the rejection of submittals.

3. Product Data.

   a. Include a catalog sheet per product of equipment listed in the Detailed Bill of Materials, in the exact order as the Detailed Bill of Materials. Each catalog sheet shall describe mechanical, electrical and functional equipment specifications. The catalog sheet must also include a image of the product. Photocopy duplications of the manufacturer's original equipment catalog sheets will be allowed as long as they provide adequate clarity of both the printed word and graphics/pictures. If more than one product is shown on the catalog sheet the intended product must be denoted by either an arrow or highlight.

4. Authorized Distributor Certificate.

   a. Recently dated (within one year from submittal date) support letter from manufacturer stating that the supplying contractor is an Authorized Distributor of the product being supplied.

5. Prequalification Warrantee.

   a. Recently dated (within one year from submittal date) support letter from manufacturer stating that the supplying contractor is Authorized to obtain for the owner the Special Warranty for Cabling System and the Special Warranty for System Assurance.

6. Prequalification Certificate.

   a. Copy of the installing technician(s) certificate of completion from the manufacturer's training school for the equipment being provided.

C. Shop Drawings are to be submitted on project standard full size and bound. Each shop drawing set is to include the below in the following order:

1. Title Sheet.

a. Containing, at a minimum, a list of all drawings in the set and a symbols legend defining each symbol used in the package.

1. Telecommunications Room Details.

a. Plan Details of infrastructure and room fittings with clearances, Elevation Details of wall fields and rack details showing the relationship of rack mounted elements inclusive of Owner provided equipment (labeled as such).

2. Typical Outlet Details.

a. Detail each typical outlet type to be installed. Include manufacturer specific plates, jacks, and an example of labeling. Note on the drawing the typical application of each outlet type, for example; standard office, computer lab, ceiling mounted wireless access location, etc.

2. Floor Plans.

b. Show planned location for all elements and cable routing. Drawings should be at project standard scale clearly legible. Include outlet port numbers for each outlet.

D. Samples to be submitted for each typical outlet type to be installed complete with colored jack, finished faceplate, and sample labeling

E. Field quality-control reports. Submit copy of project status reporting form.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer and manufactures certified installer, who shall be present at all times when Work of this Section is performed at Project site. One half of remainder of the crew shall be at a minimum Registered Technicians by manufacture as part of their Certified Installer Program.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 50 or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Installing company shall be certified by manufactures in aspects of design, installation and testing of optical and Category 6 metallic premise distribution systems, be a manufactures Value Added Reseller (VAR) in good standing and have a minimum of five (5) years experience on similar Structured Cabling Systems (SCS). Have a Registered Communications Distribution Designer (RCDD) on staff.

E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

F. Administration Standard for the Telecommunications Infrastructure of Commercial Buildings, 2002 ANSI/TIA/EIA – 606

G. Grounding: Comply with ANSI-J-STD-607-A.

H. NFPA 70 – National Electric Code, 2005

I. BICSI – Telecommunications Distribution Methods Manual, 12th Edition, 2009

J. NEMA – VE-1 – Metal Cable Tray Systems, 2002

K. NEMA – VE-2 – Metal Cable Tray Installation Guidelines, 2001

1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of UTP cable for open and short circuits.

B. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install equipment frames and ladder racking until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.10 COORDINATION

A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

B. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

C. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

D. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

1.11 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Patch-Panel Units: The greater of one (1) or 10% of total quantity of each type.
2. Connecting Blocks: The greater of one (1) or 10% of total quantity of each type.
3. Device Plates: The greater of ten (10) or 2% of total quantity of each type.

1.12 WARRANTY

A. Special Warranty for Cabling System: Manufactures warranty shall ensure against product defects; that approved cabling components exceed the specifications of TIA/EIA 568B, TIA/EIA 568B-5 and ISO/IEC IS 11801; exceed the attenuation and NEXT requirements of TIA/EIA-TSB-67 and ISO/IEC IS 11801 for cabling links/channels; and that the installation

will exceed the loss and bandwidth requirements of TIA/EIA-TSB-67 and ISO/IEC IS 11801 for fiber links/channels. The warranty shall apply to passive SCS components.

1. Warranty Period: 25 year Cabling System from date of Substantial Completion.

B. Special Warranty for System Assurance: Manufactures warranty shall cover the failure of the wiring system to support the application which it was designed to support, as well as additional application(s) introduced in the future by recognized standards or user forums that recognize TIA/EIA 568B, TIA/EIA 568B-5 or ISO/IEC IS 11801 component and link/channel specifications for cabling.

1. Warranty Period: 25 year Applications Assurance from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled. Cable support brackets in Telecommunications Rooms shall be designed to prevent degradation of cable performance and pinch points that could damage cable.

C. Provide bend limiters, if not built into the cable support, to maintain cable type bend radius whenever cable exists pathways or makes transition between two pathways.

D. Non-continuous cable supports shall be used in any area above the finished ceiling where cable tray is not available.

E. Non-continuous cable supports

1. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
2. Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables; cULus Listed.
3. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.

4. Non-continuous cable supports sized 1 5/16” and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.
5. Non-continuous cable supports shall have an electro-galvanized or G60 finish and shall be rated for indoor use in non-corrosive environments.
6. Non-continuous cable supports shall be ERICO CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64, CAT21SS, CAT32SS, CAT64SS; CAT-CMTM Double J-Hook CAT100CM; CAT-CMTM U-hook series CAT200CMLN, CAT300CMLN; and CAT-CMTM retainer CATRT200CM, CATRT300CM or approved equal.

F. Adjustable non-continuous cable support sling

1. Constructed from steel and woven laminate; sling length can be adjusted to hold up to 425 4-pair UTP; rated for indoor use in non-corrosive environments. Rated to support Category 5 and higher cable, or optical fiber cable; cULus Listed.
2. Adjustable non-continuous cable support sling shall have a static load limit of 100 lbs.
3. Adjustable non-continuous cable support sling shall be suitable for use in air handling spaces.
4. If required, assemble to manufacturer recommended specialty fasteners including beam clips, flange clips, C and Z purlin clips.
5. Acceptable products: ERICO CADDY CableCat^{TM} CAT425; or approved equal.

G. Non-continuous cable support assemblies from drop wire/ceiling

1. Fastener to wire/rod with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.
2. Acceptable products: ERICO CADDY CAT124Z34, CAT126Z34, CAT214Z34, CAT216Z34, CAT324Z34 or CAT326Z34; or approved equal.

H. Non-continuous cable support assemblies from beam, flange

1. Fastener to beam or flange with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.
2. Acceptable products: ERICO CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY beam clamps and CADDY flange clips; or approved equal.

I. Non-continuous cable support assemblies from C & Z Purlin

1. Fastener to C or Z purlin with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus listed.
2. Acceptable products: ERICO CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY Purlin hangers; or approved equal.

J. Non-continuous cable support assemblies from wall, concrete, or joist

1. Fastener to wall, concrete, or joist with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus listed.
2. Acceptable products: ERICO CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64, with CADDY angle bracket; or approved equal.

K. Non-continuous cable support assemblies from threaded rod

1. Fastener to threaded rod with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments, cULus Listed.
2. The multi-tiered support bracket shall have a static load limit of 300 lbs.
3. U-hooks and Double J-hook shall attach directly to threaded rod using standard nuts.
4. Acceptable products: ERICO CableCatTM J-hook, CAT12, CAT21, CAT32, CAT64 with CADDY CATHBA series; CAT-CMTM Double J-hook CAT100CM, CAT-CMTM Direct mount U-hook CAT200CMLN, CAT300CMLN; or AFAB series; or approved equal.

2.3 CONDUIT AND BOXES

A. Conduit and Boxes: Comply with requirements in Division 16 Section "Raceways and Boxes." Flexible metal conduit shall not be used.

1. Outlet boxes shall be no smaller than 4 inches wide, 4 inches high, and 2-1/2 inches deep.

2.4 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Berk-Tek; a Nexans company.
2. CommScope, Inc.
3. Mohawk; a division of Belden CDT.
4. SYSTIMAX Solutions; a CommScope, Inc. brand.
5. Uniprise; a CommScope, Inc. brand.
6. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
7. Hubbell Premise wire

B. Description: 100-ohm, 4-pair UTP, covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 6.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.

2.5 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hubbell Premise Wiring.
2. Leviton Voice & Data Division.
3. Nordex/CDT; a subsidiary of Cable Design Technologies.
4. SYSTIMAX Solutions; a CommScope, Inc. brand.
5. Uniprise, a CommScope, Inc. brand.
6. Panduit Corp.
7. Siemon Co. (The).
8. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
9. Ortronics Corp.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Voice Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

E. Data Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables. All patch panels shall be 48 port.

1. Number of Jacks per Field: One for each four-pair UTP cable indicated conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position eight conductor modular receptacle units with integral IDC-type terminals.

1. Comply with TIA/EIA-568-B.2, Category 6.

G. Patch Cords: Factory-made, four-pair cables in 3’-20’ in length; terminated with eight-position modular plug at each end. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure specified category performance. Patch cords shall have latch guards to protect against snagging.

1. TR location: Provide one (1) patch cord to match cable and Jack Assembly category rating per port on the patch panel.
2. Floor outlet locations: Provide one (1) ten foot modular patch cord to match cable and Jack Assembly category rating per eight-position eight conductor modular receptacle.

2.6 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

B. Workstation Outlets: Provide connector assemblies mounted in single or multigang faceplates as shown on contract drawings.

1. Plastic Faceplate: High-impact plastic. Coordinate color with Division 26 Section "Wiring Devices."
2. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.

3. Legend: Machine printed, in the field, using adhesive-tape label.
4. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.7 OUTSIDE PLANT CABLE HARDWARE

B. Manufacturers: Subject to compliance with requirements, provide products by the specified structured cabling solution manufacturer.

C. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

D. Connecting Blocks: 110-style IDC for Category 3. Provide blocks for the number of cables terminated on the block, plus 25% percent spare. Integral with connector bodies, including plugs and jacks where indicated.

A. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

2.8 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Superior Essex Inc.
2. CommScope, Inc.
3. Corning Cable Systems.
4. General Cable Technologies Corporation.
5. Mohawk; a division of Belden CDT.
6. Optical Cable Corporation.
7. Uniprise; a CommScope, Inc. brand.
8. SYSTIMAX Solutions; a CommScope Inc. brand.
9. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: Hybrid outdoor rated 12 strand Singlemode/ 12 strand Multimode, 50/125 micrometer Laser Optimized-fiber, nonconductive, loose tube optical fiber cable.

1. Comply with ICEA S-87-640for mechanical properties.
2. Comply with TIA/EIA-568-B.3 for performance specifications.
3. Jacket:

   a. Jacket Color: Black.
   b. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA–598-B.
   c. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

4. Comply with ICEA S-87-640 for mechanical properties.
5. Comply with TIA/EIA-568-B.3 for performance specifications.
7. Comply with TIA/EIA-492AAAA-A for detailed specifications.
8. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

   a. General Purpose, Nonconductive: Type OFN or OFNG.

2.9 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hubbell Premise Wiring.
2. Leviton Voice & Data Division.
3. Nordex/CDT; a subsidiary of Cable Design Technologies.
4. Panduit Corp.
5. Siemon Co. (The).
6. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
7. Ortronics Corp.
8. Corning cable systems

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, simplex and duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
2. Fiber Optic enclosures shall be rack mountable with accommodations for splice trays.
3. Fusion splice tray as needed for transition point and factory terminated pigtails.
4. LC duplex 12 fibers coupler panels shall be used for Multimode fiber.
5. LC duplex 12 fibers coupler panels shall be used for Single Mode Fiber.
6. Size fiber enclosure for 25% percent spare capacity.

C. Patch Cords: Factory-made, dual-fiber cables in one (1) meter lengths. Supply 12 LC duplex for one-half of the total termination points.

D. Patch Cords: Factory-made, dual-fiber cables in three (3) meter lengths. Supply 12 LC duplex for one-half of the total termination points.

E. Cable Connecting Hardware:

1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
2. Multi mode connector type LC.
3. Single mode connector type LC.
4. Connectors for Multimode and Singlemode shall be factory field installation via fusion splicing

2.10 OPTICAL FIBER CABLE SPLICE

A. Fiber splice shall be placed in a cabinet with tray quantities for 24 total fusion splices for transition splice in TR. Manufactured by Corning or approved equal

2.11 FIRE STOP CABLE PASS-THRU SLEEVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are limited to, the following:

1. Basis of design: Specified Technologies Inc.
2. Approved equal by:

a. 3M Corporation.
b. Hilti Corporation.
c. Wiremold- Legrand Corporation.

B. Fire Rated Cable Pathways: STI EZ-PATH Brand device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:

1. Specified Technologies Inc. (STI) EZ-PATH Series 44 Fire Rated Pathway
2. Specified Technologies Inc. (STI) EZ-PATH Series 33 Fire Rated Pathway

C. EZ-path series 44 wall sleeves in Telecommunications rooms shall be quantity as shown on contract drawings.

D. Horizontal cable pathway locations greater than 20 cables fire stop sleeves shall be STI EZ-Path series 33.

E. Horizontal cable pathway locations fewer than 20 cables EMT sleeve with UL listed system for firestopping is acceptable. Caulks and sealants shall be as manufactured by STI, 3M, Nelson, or approved equivalent.

F. Fill ratio for fire stop EMT sleeves is based on a not to exceed 40% fill capacity

2.12 GROUNDING

A. Comply with requirements in Division 27 Section "Grounding and Bonding" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.13 LADDER RACK, SUPPORTS, AND ACCESSORIES

A. Ladder Rack (Universal Cable Runway)

1. Ladder rack shall be manufactured from 3/8” wide by 1-1/2” high tubular steel with .065” wall thickness.
2. Ladder rack (side stringers) will be 9’-11½” long. Cross members will be welded in between stringers on 12” centers beginning 5-3/4” from one end so that there are 10 cross members per ladder rack. There will be 10-1/2” of open space in between each cross member.
3. Ladder rack will be delivered individually boxed, and available in the multiple widths.
4. Finish shall be epoxy-polyester hybrid powder coat (paint) black in color.
5. Design Make: Chatsworth Products, Inc. (CPI), Universal Cable Runway: Part Number 10250-712, Universal Cable Runway, 12” Wide, Black 10250-718, Universal Cable Runway, 18” Wide, Black or approved equal.
6. Design Make: Chatsworth Products, Inc. (CPI), Universal Cable Runway: Part Number 10250-724, Universal Cable Runway, 24” Wide, Black placed in vertical positions or approved equal.

B. Ladder Rack Splices

1. Splice kits will provide a method of mechanically connecting ladder rack sections and turns together end-to-end or side-to-end to form a continuous pathway for cables.
2. Grounding kits will provide a method of bonding ladder rack sections and turns together that is independent of the pathway splices. The grounding kit should be constructed of UL Listed components. The preferred solution is a #6 AWG green insulated stranded copper conductor connected on both ends to ladder rack using two-hole compression lugs and stainless steel hardware.
3. Splices (splice plates) will be manufactured from steel. Splice, grounding and insulator bar kits will include installation hardware.
4. Finish (of splice plates and hardware) shall be zinc plate in the color(s) specified below. Colors are applied as a chem. film over the zinc plate.
5. Design Make: Chatsworth Products, Inc. (CPI), Cable Runway Splices or approved equal.

C. Ladder Rack Supports

1. Supports will be sized to match the width of the ladder rack that is supported. Some supports will work with all widths of ladder rack.
2. Each support will include a means of securing ladder rack to the support.
3. Supports will be manufactured from steel or aluminum.
4. Finish shall be epoxy-polyester hybrid powder coat (paint) in the color(s) specified below or zinc plate with a gold chem. finish specified gold. Included hardware shall be zinc plated with a gold chem. finish.
5. Design Make: Chatsworth Products, Inc. (CPI), Cable Runway Supports or approved equal.

D. Ladder Rack Accessories

1. Cable straps used for attaching cable bundles to the ladder rack cross members must be reusable with a hook and loop-style closure, at least ¾” wide, and sized for cable bundles that are 2”, 3” or 4” in diameter.
2. Cable retaining posts used to keep cable from falling off of the side of the ladder rack shall be manufactured from 1” by ½” tubular steel with .065” wall thickness. Cable retaining posts will be 8” high and will attach to the side stringer of the ladder rack with included hardware. The top of the cable retaining posts will be fitted with a rubberized end cap to protect cables.
3. End caps used to cover the ends of ladder rack will be manufactured from a black fire-retardant rubberized material. End caps will be sized for 3/8” wide by 1-1/2” high side stingers and will be sold in pairs.
4. End closing kits used to cover the end of ladder rack will be manufactured from 3/8” wide by 1-1/2” high tubular steel with .065” wall thickness. Kits will consist of a bar cut to match the width of the ladder rack and the hardware required to attach the bar to the end of a length of ladder rack.
5. Radius drops used to create a radius to form cables over as the cables exit or enter the ladder rack will be manufactured from aluminum extrusion. The extrusion will be formed in a 90° arc with a minimum bend radius of 3”. Radius drops will attach to either the side stringer or the cross member of the ladder rack using a clevis pin. Radius drops will include 1-1/2” high cable spools that attach to the top of the radius drop to guide cables.
6. Movable cross members used to support cross member radius drops in between welded cross members on ladder rack will be manufactured from 3/8” by 1-1/2” aluminum bar. Movable cross members will attach to ladder rack at the side stringers with included hardware so that the location of the movable cross member can be adjusted. Moveable cross member will support a cross member radius drop.
7. Cable spools used to separate ladder rack into multiple cable pathways will be made from a black flame retardant ABS. Cable spools will attach to the cross members with a clip that allows the width of the ladder rack to be divided into any proportion. The spools will be 3.94” tall, with a 1.94” diameter top, and a body that tapers from .88” (diameter) at the top to .62” (diameter) at the bottom.
8. Auxiliary support brackets used to support cables that should be physically separated from the cables in the ladder rack will be made from 1/8” x 1” steel bar. The bracket will be L-shaped and will attach to the side stringer of the ladder rack. The bracket will hang below the ladder rack a minimum of 4”. The bracket support surface will be 4” long. The bracket will be zinc plated with a gold chem. finish.

9. Touch-up paint used on ladder rack and ladder rack system components will be color-matched to the finish on the ladder rack or component. A spray on and brush on option will be available.
10. Unless otherwise noted, finish on all metal components shall be epoxy-polyester hybrid powder coat (paint) black in color. Hardware will be zinc plated with a gold chem. finish.
11. Design Make: Chatsworth Products, Inc. (CPI), Cable Runway Accessories or approved equal.

2.14 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches A-C Grade.

1. Provide materials that comply with performance requirements in AWPA C27. Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5516, for plywood.

B. All 4 walls shall be covered with rigidly fixed 3/4 inch A-C plywood with the A grade side facing outward. The plywood shall be void free and extend from 6 inches above the finished floor (AFF) to 102 inches AFF and capable of supporting the attached equipment.

C. Comply with requirements in Division 09 Section “Paints and Coatings" for fire-retardant plywood.

2.15 POWER STRIPS

A. Each equipment rack is to contain a rack mounted power distribution panel that is to occupy the first rack space in each rack. Power distribution shall be: Geist RacSense (RCXRN102-102D20ST5) or equal.

2.16 UNINTERRUPTIBLE POWER SUPPLY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are limited to, the following:

1. MinuteMan
2. TrippLite
3. American Power Company (APC)
4. Approved equal

B. Each equipment rack shall contain a rack mounted local uninterruptible power supply (UPS). The UPS shall be able to support its' associated rack enclosure in an active state of operation for not less than thirty-minutes.

2.17 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Division 16 Section "Electrical Identification."

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Install pathways complying with recommendations in TIA/EIA-569-A, "Entrance Facilities" Article.

1. Install entrance pathway complying with Division 26 Section "Raceways and Boxes."

3.2 INSTALLATION OF PATHWAYS

A. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

B. Comply with requirements in Division 16 Section "Raceways and Boxes" for installation of conduits and wireways.

C. Install manufactured conduit sweeps and long-radius elbows whenever possible.

D. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard when entering room from overhead.
4. Extend conduits 3 inches (76 mm) above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.3 NON-CONTINUOUS CABLE SUPPORTS

A. Installation and configuration shall conform to the requirements of the current revision levels of ANSI/ EIA/TIA Standards 568 & 569, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer's installation instructions.

B. Do not exceed load ratings specified by manufacturer.

C. Adjustable non-continuous support sling shall have a static load limit of 100 lbs.

D. Follow manufacturer's recommendations for allowable fill capacity for each size non-continuous cable support.

3.4 WIRING METHODS

A. Wiring Method: Install cables in raceways, J hooks, and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables accessible ceilings, walls, and floors except in unfinished spaces.

B. Install plenum cable in environmental air spaces, including plenum ceilings.

C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

D. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

E. Provide equipment frames and ladder racking as outlined in telecommunications series drawings.

3.5 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. In the communications equipment room, install a 10-foot long service loop on each end of cable.
11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
3. Terminate patch panels and outlets to a pin/pair assignment as directed by owner.

D. UTP Patch Cords

1. Provide modular cords required to connect LAN switches to modular jacks on cross connect panel shall be furnished as part of this solicitation. Quantities should be equal to the total number of network outlets. At the Patch panel location provide patch cable lengths as needed for a neat installation utilizing vertical wire managers. At the user outlets provide 10 foot patch cables for each 8 pin modular connector

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Group connecting hardware for cables into separate logical fields.

G. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.6 INSTALLATION TELECOMMUNICATIONS ROOMS

A. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

B. Bond the shield of any shielded cable to the grounding bus bar in communications rooms and spaces.

3.7 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."

B. General: Install through-penetration firestop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.

C. Install EZ Path modular floor grid system in Telecommunications Rooms as shown on contract drawings.

D. Install EZ Path Series 44 modules in Telecommunications Rooms as shown on contract drawings.

E. Install EZ Path or EMT sleeve where horizontal cables penetrate a fire or smoke rated wall.

F. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of firestopping products.

G. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

H. Comply with BICSI TDMM, "Firestopping Systems" Article.

I. Any penetrations created for the passage of telecommunications which remains vacant at the completion of the installation shall be fire stopped.

3.8 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with requirements in division 27 05 26 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

C. Comply with ANSI-J-STD-607-A.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.9 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 16 Section "Electrical Identification."

B. Comply with requirements in Division 9 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an AutoCad electronic copy of final comprehensive schedules for Project.

D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish AutoCad - latest version -electronic record of all drawings.

E. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

    1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.10 SOURCE QUALITY CONTROL

A. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

B. Factory test UTP cables according to TIA/EIA-568-B.2.

C. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

D. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

E. Cable will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect UTP, multi-pair copper and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually confirm cable category marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. Optical Fiber Cable Tests:

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    b. Link End-to-End Attenuation Tests:

        1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
        2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

6. UTP Performance Tests:

    a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:

        1) Wire map.
        2) Length (physical vs. electrical, and length requirements).
        3) Insertion loss.
        4) Near-end crosstalk (NEXT) loss.
        5) Power sum near-end crosstalk (PSNEXT) loss.
        6) Equal-level far-end crosstalk (ELFEXT).
        7) Power sum equal-level far-end crosstalk (PSELFEXT).
        8) Return loss.
        9) Propagation delay.
        10) Delay skew.

7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.3.
8. Coaxial cable and video signal testing shall be performed in the following manner to verify correct installation of coaxial cable and video system electronics:

    a. Input Signal @ 450 MHz Output Output @ chi. 7
    b. (after pad & equalizer) @450 MHz (175.2 MHz) +6 dBmv (+/- 1 dbmv) +40 dBmv after amplifier (+/- 5dbmv)
    c. The output of directional couplers and FFTs shall be at least +9 dBmv.

9. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.

    a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
    b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

C. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

3.12 DEMONSTRATION

A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

3.13 REPAIR/RESTORATION

A. Protect adjacent surfaces. Repair damage to any surfaces occurring as a result of the work of this Section. Repair of surfaces shall include re-painting in accordance with Division 09 Section “Painting.”

3.14 CLEANING

A. At the completion of the System, restore aspects of the project site to its former condition. Remove daily waste and excess materials, rubbish debris, tools and equipment resulting from or used in the services provided under this Contract. Remove trash from all work areas. Do not use dumpsters or trash disposal without prior approval.

END OF SECTION 27 10 00

SECTION 28 13 00 - ACCESS CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Access control.
2. Stranded power and control cable.
3. Cable connecting hardware, patch panels, and cross-connects.
4. Cable management system.
5. Cabling identification products.
6. Grounding.
7. Pathways.
8. Intrusion Detection Motion Sensors

B. Related Sections

1. 271000 – Telecommunications Structured Cabling
2. 282300 – Video Surveillance Systems

C. System Requirements

1. Install and integrate a completely functional Access Control System and related security hardware including power supplies, UPSs, server/client software, licenses, related security hardware and Owner Furnished Equipment as specified and as detailed in associated contract drawings.
2. Configure local access panels in telecommunication rooms (TR) and the Server's computer system to communicate with one another.
3. Enter security system databases hardware configuration.
4. Test security system communication and operation in accordance with the specification.
5. Train operators and the system managers.

1.2 REFERENCES

A. The Codes and Regulations listed below form a part of this specification to the extent referenced. Work shall be performed in accordance with the applicable international, federal, state, and local codes or standards current at the commencement of installation. The following list summarizes applicable standards:

1. UL 294, UL 1076, ULC
2. CE
3. FCC – Part 15, Part 68
4. NFPA 70, NEC
5. IEEE, RS 170 variable standard

6. RoHS

B. Where more than one code or regulation is applicable, the more stringent shall apply.

C. Cable and equipment installation, identification and termination shall be performed in accordance to the applicable codes above.

1.3 DEFINITIONS

A. ADA: Americans with Disabilities Act

B. Bid: Herein, used interchangeably with “proposal”

C. Demarc: “Demarcation Point” marking the location where communications facilities owned by one organization interface with that of another.

D. DVR: Digital Video Recorder

E. GUI: Graphical User Interface

F. LAN: Local Area Network

G. IP: Internet Protocol

H. IR: Infrared

I. NIC: material and work which is Not In Contract and for which the Installer is not responsible except as otherwise detailed herein.

J. NVR: Network Video Recorder

K. OFE: “Owner Furnished Equipment” which will be provided by The Owner. Be responsible for installing and integrating this equipment as detailed herein.

L. OFCI: “Owner Furnished Contractor Installed” Equipment which will be provided by The Owner. Be responsible for installing and integrating this equipment as detailed herein.

M. OSP: Outside Service Plant

N. PoE: Power over Ethernet

O. TR: Telecommunications Room

P. UPS: Uninterruptable Power Supply

Q. The term “shall” is mandatory.

R. The term “will” is informative.

S. The term “should” is advisory.

T. Term “provide” means furnish and install.

U. Security Consultant: Convergent Technologies Design Group, Inc.

V. SMS: Security Management System

W. Bidder: Qualified firm intending to tender a bid on the systems described herein.

X. Owner: Delaware Technical and Community College, herein referred to as “DTCC”.

Y. Construction Manager (CM) or General Contractor (GC): The representative responsible for general building construction and onsite coordination between sub-contractors

1.4 BID PROPOSALS

A. Itemized Bid Response

1. Each piece of equipment shall be individually priced and submitted with Bid Proposals. Provide itemized bid response to include equipment description, manufacturer, model number, unit price, and quantity. All equipment prices shall reflect required modifications and accessories as needed for a complete and functioning system.
2. Non-equipment charges shall be outlined separately as a single line item. A sum of the video surveillance system total cost shall be provided with the bid proposal.
3. Lump sum bids will not be accepted.

B. Contractor Qualification

1. Demonstrate at least three (3) years experience in the fabrication, programming, assembly, and installation of access control systems of similar magnitude and quality as specified for the subject job. Submit documentation to this effect with the bid response. Be an authorized sales and service center for all listed components and offerings in this specification.
2. References: Furnish no less than three (3) references for installations of similar size (dollar amount & quantity of spaces receiving integrated technology) and scope, performed throughout the Dover, Delaware area within the past three (3) years. At a minimum, reference information will include the reference company or institute name, contact person’s name and title, telephone number, address, and detailed project description, project manager’s name, and contact information of the organization that is responsible for day-to-day operation of the video surveillance installation.
3. Bidders shall include as part of the bid response the following items:
4. Letter of approval from the manufactures indicating compliance with qualification requirements.
5. Installation schedule with proposed manpower assignments,
6. Resumes for project manager, lead engineer and certification of NICET Video Security System Technician Level 4, as well as ASIS CPP certification for this project.
7. Training certificates for design, engineering and installation of the proposed products shall be submitted with the proposal.
8. Service Dispatch outline containing the type of service program used for dispatching and tracking service calls.

C. Alternate Proposals

1. Any proposed alternate equipment choices should be requested in writing prior to the proposal submission for approval. Each item on the alternate equipment list must be accompanied by catalog cut sheets and technical specifications.

D. Non-Equipment Charges, Including but not be limited to:

1. Engineering: Including all required design drawings, run sheets, instruction manuals, console layout, step-by-step user guide, etc.
2. Pre-Installation: Work performed on the Installer's premises including all fabrication, modification, assembly, rack wiring, etc.
3. Installation: Including all on-site installation and wiring, shop drawing, coordination and supervision, testing, checkout, Owner training, etc., performed on the Owner's premises.
4. General and Administrative: Including all shipping, insurance, and guarantees.

E. Owner Furnished Equipment (OFE, OFCI)

1. Identify any Owner Furnished Equipment assumed in the Bid Proposal to be installed and integrated under this contract. Identify all assumed Owner Furnished equipment within each room/space type that will be required to complete the AV systems installation.

F. State of the Art Development

1. Supply only the manufacturer's latest developed product. In cases where product development surpasses the criteria of the specification, inform the Architect and make the newer product available to the project at no additional cost. In no case shall discontinued or obsolete equipment be acceptable. The same requirement applies to software programs developed/updated during the warranty period.
2. Should a manufacturer discontinue a specified product, provide the manufacturer's recommended replacement at no additional cost to the owner. Should the manufacturer have no direct replacement product, the video surveillance contractor shall propose a product of equal or greater specification from an alternate manufacturer at no additional cost to the owner.
3. Should a product recall by a specified manufacturer require temporary or permanent replacement of a product specified under this section, notify the Architect at the earliest possible time and arrange to replace the product in question as quickly as possible.

    a. Equipment found defective or subject to recall prior to scheduled installation shall not be delivered to the jobsite.
    b. Equipment defect or intended recall shall not relieve the video surveillance contractor from any contractual obligations with regard to delivery schedule of product.
    c. Under no circumstances shall arrangement for alternate product require the Owner to accept superseded equipment except on a temporary basis.

G. Service Contract

1. Submit the costs for a one-year service contract, renewable for up to three years, which shall commence with the completion of the two-year warranty period. These contracts shall be fixed-cost, and can be accepted at the option of the Owner.
2. The service contract shall include all of the services provided during the warranty period, including complete replacement or repair of defective equipment.

1.5 QUALITY ASSURANCE

A. Coordination

1. 271000 for pathways, cabling locations, colors, termination ports, and all OSP Demarc locations related to video surveillance systems.
2. Test and verify structured cabling installed to support the video surveillance system.
3. Coordinate layout and installation of Access Control Systems equipment with Owner's security representative.

    a. Meet jointly with Owner to exchange information and agree on details of equipment arrangements and installation interfaces, as well as integration into the existing Access Control system.
    b. Record agreements reached in meetings and distribute them to other participants and the project Architect for design team distribution.

4. Coordinate this Section with work of other Project Manual sections and associated trades.
5. Specific references, herein, requiring coordination of certain work shall not obviate responsibility for other required coordination.

B. Unspecified Equipment and Material

1. All equipment and materials not specifically addressed on the drawings or in this document and required to provide complete and functional video surveillance system shall be provided in a level of quality consistent with other specified items.

C. Standards and Codes

1. Comply with

    a. Local, state and federal codes
    b. Applicable National Electrical Code
    c. American National Standards Institute
    d. Underwriters' Laboratories, Inc. standards.

2. All equipment, material, accessories, and loose items shall be new and shall conform to applicable requirements of the above-mentioned agencies.
3. If required by local authorities, provide certificates and labels indicating compliance with above-mentioned codes and standards where applicable.

D. Point of Contact

1. Designate to the Owner in writing, the responsible person who shall ensure timely and consistent communication with the Owner on progress of the contract. The designated representative shall have full knowledge of all engineering and production procedures and shall report status of the installation and upcoming work plans to the Owner's Project Manager and Consultant on a weekly basis.
2. Project manager shall have successfully managed not less than two (2) projects of similar size and scope (as defined in previous sections). Bid submission shall detail the percentage of time that the project manager and other key personnel will be involved with the project.

1.6 SCOPE OF WORK

A. Provide the following in accordance with Specifications and Drawings

1. Submittals delivered in a timely manner as described hereinafter.
2. Verification of dimensions and other conditions at project site. Review conduit system as shown in electrical section of building construction documents and, where applicable, as built conditions. Notify Consultant, Architect, GC, and EC within four weeks after award of contract of any deficiencies or inadequacies in conduit system design.
3. Detailed design of surveillance system GUI, system "maps," including remote-control accommodations.
4. Power distribution and battery backup within equipment racks and wall fields including power connection to electrical outlets as described in electrical section of building construction documents.
5. Incidentals necessary for a complete working system.
6. Initial testing and adjustments, demonstration of system for approval, participation in acceptance tests, final adjustments as required.
7. Record Documents, "As-Built" drawings and Owners Manual.
8. Training of operating personnel.
9. Notify appropriate parties of conflicts in a timely manner.
10. Work cooperatively with other trades to resolve conflicts.

B. Special Insurance

1. Provide insurance fully covering all equipment against loss, damage, and theft during shipment, storage, installation, testing, adjustment and demonstration.

1.7 SYSTEM DESCRIPTION

A. DTCC currently uses electronic access control systems with proximity card readers and electronic lock sets furnished and integrated by Advantech (www.advantechsecurity.net).

B. All access control or documentation systems shall be recorded and stored using the existing Access Control monitoring and control software system and administered by DTCC Security Representatives.

C. All building and room access control systems shall be systems, equipment, and accessories compatible with the current Advantech access control system. All auxiliary accessories or supporting devices shall be fully compatible with and able to integrate with existing campus system.

D. The SMS shall be able to seamlessly interface with and monitor intelligent system controllers, reader interface modules, I/O panels, burglar alarm panels, burglar alarm panel receivers, personal protection devices, intercom systems, fire alarm panels (secondary monitoring only), building management systems and digital/network video recorders and software.

E. The SMS shall be able to communicate with intelligent system controllers via TCP-IP/Ethernet.

F. Design Intent

1. Provide a complete and functioning video surveillance system inclusive of all hardware, software and training to meet or exceed the performance features outlined in this document.

G. Design Standards

1. The Owner's goal is to have available a cohesive and fully functional system. Therefore, part of the development efforts for successfully implementing the video surveillance system should include:

   a. Access control systems shall be designed and installed to not interfere with egress requirements for life safety nor interfere with intrusion or fire alarm systems.
   b. All access controlled handicap entrances shall be fully integrated into the building access control system ensuring that while providing access to the disabled, that proper access control is maintained in both the unsecured and secured modes. Access control systems shall be installed to comply with Americans with Disabilities Act and DTCC policies.
   c. All access control installations shall using housings and mountings which maintain or minimize disruption to architectural sensibilities or themes of the buildings and campus.
   d. All access control installations shall using housings and mounting designed to provide sufficient protection against tampering and vandalism. Torx center pin security fasteners shall be used on all devices installed in public areas.
   e. All equipment and components to support access control system shall be installed to manufacturer's specifications. Installation of components and hardware shall be in place prior to connection to the access control system.
   f. Installations of control access system equipment hardware shall comply with DTCC requirements.
   g. All access control systems shall be configured to provide a Fail Secure with mechanical manual egress from the secure side in the event of a loss of power, loss of network communications, or system failure.
   h. All access control equipped doors locking hardware shall include keyed locking mechanisms accessible from the unsecured side to allow keyed manual operation of the door.
   i. All access control equipped doors shall be keyed to a key system designated for access controlled doorways.
   j. All access control equipped doors shall be equipped with door position monitors and proximity card readers to allow for configuration of door condition alarms.
   k. All access controlled system equipment, including controllers and power supplies, shall be located in accessible and secure rooms; with Telecommunication/ IDF rooms being preferred.
   l. Electric power supplies and power converters for the access system equipment and hardware shall be connected in the Telecommunications/IDF room. Power supplies located at the access equipped door should be avoided.
   m. Electrical service to access control power supplies shall be on dedicated circuits. Where practicable, electric power for the access system should be provided through the building emergency power supply.
   n. All access control equipment power supplies shall be equipped with battery back up to allow operation if electrical service and emergency generated power is lost.
   o. As a minimum, provide conduit from all access devices, hardware, and equipment to ceiling location to allow for convenient access to raceways for cabling.
   p. All new construction installation of access control systems shall be hardwired. In renovation or retro-fit installations hardwired installations are preferred; wireless systems

may be considered with the approval of Access Services, and Project Manager, and building owner.

q. Wiring Connection Requirements: All low voltage control, monitor, power, and other cables shall be connected using sealed crimp type lugs, no wire nuts will be allowed.

r. Monitor Contacts: Door monitoring contacts, and wiring and conduits there to, shall be concealed and invisible when the door is closed. Externally applied door monitoring contacts, externally applied conduit or wire mold, and wire without conduit must be approved by Access Services, Project Manager, and building owner.

s. Request to Exit Switches: Request to exit (RX) switches should be mechanically hardware based devices. Passive infrared (PIR) or sonic detectors should only be used when no mechanical method is available.

1.8 SUBMITTALS

A. Related Sections

1. Comply with requirements of Section 01 33 00 - Submittal Procedures.

B. Submittal Data

1. Submittal data is to be submitted in a three ring binder, a continuous spiral binder, or plastic binding that allows the booklet to lie flat while open. Each booklet shall contain the below in the following order:

a. Cover Sheet.

b. Include name of supplying contractor and project name.

c. Detailed Bill of Materials.

d. Include a listing of: component quantities, equipment manufacturers, model numbers, and description of each component being supplied, and the specification paragraph or drawing sheet that corresponds to the product. Failure to provide this information will result in the rejection of submittals.

e. Product Data.

f. Include a catalog sheet per product of equipment listed in the Detailed Bill of Materials, in the exact order as the Detailed Bill of Materials. Each catalog sheet shall describe mechanical, electrical and functional equipment specifications. The catalog sheet must also include an image of the product. Photocopy duplications of the manufacturer's original equipment catalog sheets will be allowed as long as they provide adequate clarity of both the printed word and graphics/pictures. If more than one product is shown on the catalog sheet the intended product must be denoted by either an arrow or highlight.

g. Authorized Distributor Certificate.

1) Recently dated (within one year from submittal date) support letter from manufacturer stating that the supplying contractor is an Authorized Distributor of the product being supplied.

C. Shop Drawings

1. Prior to fabrication submit contractor generated drawings for approval for all supplied systems. These drawings shall include, but are not limited to, the following:

a. Title Sheet & Symbols Legend
b. Telecommunications Room Details: Elevation Details of wall fields and rack details showing the relationship of rack mounted elements inclusive of Owner provided equipment (labeled as such).
c. All panels, plates, and designation strips, including details relating to terminology, engraving, finish and color.
d. All equipment racks, cabinets, consoles, tables, carts, support bases, and shelves.
e. Schematic drawings (Video Surveillance), system functional block drawings. Resubmission of contract drawings is unacceptable.
f. All unusual equipment modifications.
g. Front mechanical drawings of each equipment rack.
h. Equipment location drawings.
i. Cable labeling plan.
j. Floor Plans, RCPs and Elevations: Show planned location for all elements and cable routing. Drawings should be at project standard scale and clearly legible.

D. Form

1. Submit all materials for review as described above, specifically referenced to the Specification paragraph number (where applicable).

a. Submit all drawings on sheets of one size, preferably the project standard size.
b. Where materials are presented on sheets 11” x 17” or smaller, organize into three-ring binder which include:

1) Dividers or tabs between logical sections
2) Project name and binder title labels on face and edge of binders

c. On submittal drawings, maintain 3/32” minimum lettering height. Submittals with text less than 1/16” in height may be rejected.

2. Partial Submittals may be rejected. If submitted individually and each in its entirety, the following Submittals shall not be considered partial:

a. Personnel
b. Milestones
c. Conduit Verification Statement and Notifications
d. Rigging and Mounting Drawings
e. As-Built Documentation

3. Product Data and Shop drawings must be submitted together in order to be reviewed.

E. Weekly Reporting

1. Commencing with project award, provide weekly status reporting of milestone task status, anticipated completion date, and related memo notes for the following tasks:

a. Submittals
b. Infrastructure verification
c. Pre-wire status

d. Equipment Procurement
e. Shop fabrication
f. Remote control system design
g. Installation and Terminations
h. Field testing and pre-acceptance testing
i. Final acceptance demonstrations
j. Owner training
k. First owner use
l. Open Coordination Items and Questions

2. See below for a partial example of an acceptable weekly reporting list.

Project:	*Project Name*			
Location:	*Project Location*		Date:	*Form Delivery Date*
Project Manager:	*Project Manager*		Delivered by:	*Form Delivered By*
		Projected Completion:	Status:	Notes:
Infrastructure Verification:		*6/1/2011*	*Complete*	
Submittals:				
	Product Data	*8/1/2011*	*Complete*	
	Drawings	*8/1/2011*	*Complete*	
	Personnel (etc.)	*8/1/2011*	*Complete*	
RFIs:				
	12	*8/25/2011*	*Received*	*Implementing*
	178	*9/6/2011*	*Pending*	*Projector Screen Clearances*

Installation Status by Space

Room			Equipment				
Name	Number	Pre-Wire	Order	Receive	Install	Test	Notes:
Example 1	*105*	*100%*	*100%*	*100%*	*60%*	*0%*	*Re-programming*
Example 2	*135*	*100%*	*100%*	*100%*	*90%*	*0%*	*Other Notes Here*

F. Personnel

1. Provide, in writing, within two weeks after award of Contract, the names, mailing address, phone numbers with extensions, email addresses and paging service numbers (if available) of the following project personnel:

a. Project Manager
b. Lead Systems Engineer
c. Field Foreman
d. Remote Control System Programmer
e. Conduit Verification

2. Within four weeks after award of Contract, submit statement confirming that Contractor has reviewed the conduit system as designed in building construction documents and, where applicable, as built.
3. Notify Consultant, General Contractor, Architect or Electrical Contractor of deficiencies or inadequacies, if any, in conduit system design or installation. If none, so indicate.
4. Absent conduit verification by Contractor and after installation of conduit as designed, Contractor shall assume costs of equipment, materials, labor and engineering, including services of owner's representative(s) in designing and/or verifying revised wiring approach(es) as relate to providing a fully functional system using conduit as designed or as revised at the discretion of the owner.

    a. Rigging and Mounting Drawings

5. Submit full size drawings outlining mounting and installation details of all video surveillance equipment requiring integration with cabinetry or architectural elements.
6. Details, stamped and signed by an appropriately licensed engineer, of all equipment mounting methods and materials provided by the Scope of Work, wherein failure of method or materials used for mounting or hanging permanently installed equipment could result in serious personal injury.

    a. Details provided by or requiring approval by licensed engineer may include: method of attachment to building structure or attachment and/or suspension points; method of attachment to supported equipment; all suspension materials; a materials list including specifications of all suspension materials; calculations used to determine loads and strengths of suspension materials, other as deemed necessary by the engineer.

7. In the absence of submitted approved, stamped and signed mounting and hanging details, the Owner reserves the right to acquire such engineering approval at the expense of the Contractor. Owner will notify Contractor of such intent. Contractor shall remedy within two weeks or Owner may proceed without Contractor approval and without relieving Contractor from any other obligations set forth by Contract.

    a. Color Selection

8. Color options for all items as applicable.

    a. Color options for all items as applicable.
    b. Detector and local sounder plate finishes should be coordinated with the Architect.

1.9 CLOSEOUT SUBMITTALS

A. At the completion of the installation, but before Final Acceptance, provide for review and approval the following, in compliance with Division 1 Section *Closeout Procedures*.

1. Operation and Maintenance Manuals:

    a. Equipment manufacturer's operation and service manuals for each make and model of equipment.
    b. System Operation Manual. Produce a manual specifically for the subsystems detailed herein. The manual shall describe all procedures necessary to activate each system to

provide for the functional requirements, except as specifically excluded by the Owner. This section shall provide a simple "How-to" users guide for the procedures needed to operate the system. This document shall contain a section on operating the systems equipment in the event of control system failure. Control system touch panel layouts shall be accompanied by narrative text describing "step-by-step" function engagement.

B. Warranty

1. Provide list and dates of activation of equipment warranties
2. Provide original manufacturers' certificates.

C. As-built Drawings

1. Include contractor generated (mark-up of contract documents is not acceptable) digital record diagrams for all systems including, but not limited to:

   a. Schematic wiring diagrams with cable markings.
   b. Internal wiring diagrams of the equipment rack cabinets.
   c. Custom equipment modifications.
   d. Final test results and nominal settings for all adjustable controls.

D. Software Passwords

1. Software Passwords Schedule (i.e., a spreadsheet listing the manufacturer, model number and location in the Facility, of each piece of video surveillance equipment, the software for which is password-protected).
2. Provide to Owner's Representative as a secure document separate from Operating and Maintenance Manuals and As-Built Drawings.

E. Editable Control System Code

1. Provide the final control system code in an editable format.

F. Laminated Instruction Cards

1. Provide 8 ½ x 11 Instruction cards, approved by the Owner. Laminate step-by-step instructions outlining system operations for the video surveillance system. Provide editable file of card to Owner.

1.10 DELIVERY, STORAGE, HANDLING, AND STAGING

A. Supply, transport, deliver, unload, move to the installation location, unpack, place, assemble, secure, connect, and install all equipment needed to complete the installation. Be responsible for transportation, parking, delivery, and on-site storage of the system's equipment. Be responsible for all transportation of personnel to and from the site.

B. Reconfirm before delivery that hallways, stairways, passages, doorways, rooms, entries, elevators and foyers are of sufficient size to accommodate the passage and installation of the equipment and systems. Off-site pre-staging of goods is encouraged.

C. The Owner's acknowledgment of delivery of goods and any payment made on account of such delivery shall not constitute acceptance (partial or otherwise) and shall not diminish obligations as specified.

D. The actual dates of delivery shall be under the absolute control of the Owner. The dates and times for delivery/installation are critical to the successful completion of the project. In the event it becomes necessary for goods to be installed outside these hours comply with the instructions of the Owner. Deliveries attempted outside these hours without prior consent of the Owner may be turned away. Comply with all instructions of the Owner and the Contractor concerning time of arrival at the site; which entrance shall be utilized for delivery; routes to be taken to reach the installation location; and other matters relating to the orderly and timely installation of the system.

E. Installation shall commence immediately upon delivery of materials to the jobsite, except as directed by Construction Manager. Time required from delivery date to completion of project shall be in accordance with the approved schedules.

F. Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

G. Do not deliver or install equipment until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.11 SYSTEM TRAINING

A. Training: Provide training in the operation and maintenance of the system for personnel designated by the Owner. Record owner training sessions on DVD or other agreed upon media, and make training videos available to the owner at no charge. The training shall be organized as follows:

1. Two (2) two-hour training classes for system technical operation and maintenance. This class shall cover the following topics:

    a. Review of signal flow diagrams.
    b. Review of all equipment functions, relevant to the function in this system.
    c. Review of initial equipment settings.
    d. Demonstration of all functional connections from a user perspective.
    e. Review & demonstration of replacement procedures for consumables
    f. Review of manufacturers' recommended routine maintenance procedures.
    g. Review & demonstration of system software replacement/upgrade procedures.

2. Training may take place at any time (chosen by the Owner) after the systems are operational, up to a year following system acceptance.
3. Close out submittals shall be provided prior to any training classes.
4. Coordinate detailed specifics of the training session(s) time, date & location with the Owner.

1.12 WARRANTY

A. The system warranty shall be for twenty-four (24) months from the date of final acceptance. Provide all equipment, material, and labor required to uphold a full system warranty at no charge to the Owner. All

manufacturers' equipment warranties shall be activated in the Owner's name and shall commence on the date of final acceptance. In the case of modified equipment, the manufacturer's warranty is normally voided. In such cases, provide the Owner with a warranty equivalent to that of the original manufacturer.

B. There shall be no cost to the Owner for maintenance performed during the warranty period beyond the fixed cost of the contract.

C. Provide a total of eight (8) one-day visits per year, or a total of sixty-four (64) engineering/ service labor hours to conduct preventive maintenance and the Owner directed system adjustments.

D. Repair and/or adjust any malfunctioning components located by the technician during this testing. Include control system programming updates and modifications as part of this service contract, providing an updated editable copy of the source code to the Owner.

E. Provide a service telephone number, staffed by a qualified technician familiar with the equipment installed. Staff this number during normal business hours.

F. Respond with an on-site technician within 24-hours of a service call (including Saturdays and Sundays) for all equipment and system failures.

G. Replace or repair, at no cost to the owner, any failed equipment hardware or software installations required to provide full system operations.

H. During the warranty period, advise the Owner in writing each time any routine software and firmware updates become available, giving the Owner the opportunity to upgrade the software/hardware should they so desire at no additional cost. Provide any necessary system modifications after installation of these updates to maintain a fully functioning system.

I. Provide updates to firmware during service period. Provide any necessary system modifications after installation of these updates to maintain a fully functioning system.

J. The warranty period for any part which has a warranty by the manufacturer of longer than 24 months shall be for the longer period. Provide a copy of the manufacturer's warranty period statement for all major Access Control components.

PART 2 - PRODUCTS

2.1 ACCESS CONTROL BUNDLE

A. Plenum overall jacket, components listed below:

1. SHLD 18awg-4/c (printed: lock power) plenum jacket

   a. Larger gauge wire may be required to compensate for voltage drop over longer distances.

2. SHLD 22awg-3/PR (card reader) plenum jacket
3. SHLD 22awg-2/c (door contact) plenum jacket

4. SHLD 22awg-4/c (rex/ spare) plenum jacket
5. Door monitor cable - SHLD 22awg-2/c Plenum (door contact) plenum jacket.
6. Power cable – 16awg-2 conductor plenum jacket.
7. Lockout switch cable- 22 awg-2/c plenum jacket (lockout).

2.2 READERS

A. Provide appropriate licensing to include added equipment in this section to the existing configuration/system.

B. Exterior Door Proximity Card Reader

1. Dimensions 3.135” x 1.72” x 0.66”
2. Power: 5 - 16 VDC
3. Operating Temperature: -22 to 150 degrees F
4. Operating Humidity: 0% - 95% relative non-condensing
5. Provide weatherized enclosure

Product: HID Global ProxPoint Plus Reader 6005 or approved equal.

2.3 ACCESS CONTROLLER DEVICES

A. Provide appropriate licensing to include added equipment in this section to the existing configuration/system.

B. Provide star configuration for master controller/door controller interconnection.

C. Master Controller

1. 32,000 cardholder database
2. 4x20 LCD for displaying configuration status
3. Supports up to eight (8) doors in daisy-chain or star configuration
4. RJ45 Ethernet port for communication to the web-based Blackboard Transact system

D. Door Controllers

1. Supports up to two (2) card readers
2. Input Voltage: 100-240VAC @ 50/60Hz, 1A max
3. Aux Power Output: 24VDC, 1A max (fused)
4. Reader Power Supply: +12VDC, 1A max (combined all readers)
5. Relays: Alarm, Aux, Bypass, Lock, Tamper (1A @ 30VDC)
6. Inputs: Door, Request to exit, Latmon, Spare, AC fail, Battery low, Tamper (24VDC max)

2.4 POWER SUPPLIES

A. Altronix Corp. power supplies shall be used unless otherwise specified with a preference to the Maxim series.

B. Altronix Corp. Maxim series power supplies with fused output distribution (Altronix PD8UL) for both power supplies.

1. Maxim11E.
2. Maxim13E.
3. Maxim33E.
4. Maxim35E.
5. Maxim37E.
6. Maxim55E.
7. Maxim75E. (preferred)

C. Altronix Corp. FailSafe/Fail Secure Multi-Output Access Power Controller Power Supply/Charger

1. AL1024ULACM
2. AL1024ULACMCB

2.5 DATA/NETWORK

A. One (1) assigned and static IP address accessible data port/connection shall be provided for each controller panel installed.

2.6 PANIC BUTTON

A. Provide Honeywell model 269R Panic Buttons at locations identified on drawing sheet TA101.

B. Panic buttons to be mounted underneath desk, coordinate exact location with owner representative.

C. Activation of panic button shall immediately signal the locking mechanism on the associated access control door to lock. Doors with panic buttons shall also be capable of locking automatically during nighttime hours.

D. Provide all cabling, programming, and licensing required for integration of panic buttons.

2.7 INTRUSION DETECTION MOTION SENSORS

A. Provide Honeywell model 5898 Motion Sensors at locations identified on drawing sheet TA101.

B. Motion Sensors to be mounted 6” below finished ceiling.

C. Provide all mounting hardware, batteries, programming, and licensing required for integration of Motion Sensors into existing Access Control system.

PART 3 - EXECUTION

3.1 GENERAL DESIGN STANDARDS

A. Access control systems shall be designed and installed to not interfere with egress requirements for life safety nor interfere with intrusion or fire alarm systems.

B. All access controlled handicap entrances shall be fully integrated into the building access control system ensuring that while providing access to the disabled, that proper access control is maintained in both the unsecured and secured modes. Access control systems shall be installed to comply with Americans with Disabilities Act.

C. All access control installations shall using housings and mountings which maintain or minimize disruption to architectural sensibilities or themes of the buildings and campus.

D. All access control installations shall using housings and mounting designed to provide sufficient protection against tampering and vandalism. Torx center pin security fasteners shall be used on all devices installed in public areas.

E. All equipment and components to support access control system shall be installed to manufacturer's specifications. Installation of components and hardware shall be in place prior to connection to the access control system.

F. All access control systems shall be configured to provide a Fail Secure with mechanical manual egress from the secure side in the event of a loss of power, loss of network communications, or system failure.

G. All access control equipped doors locking hardware shall include keyed locking mechanisms accessible from the unsecured side to allow keyed manual operation of the door.

H. All access control equipped doors shall be keyed to a key system designated for access controlled doorways.

I. All access control equipped doors shall be equipped with door position monitors and request to exit devices to allow for configuration of door condition alarms.

J. All access controlled system equipment, including controllers and power supplies, shall be located in accessible and secure rooms; with Telecommunication/ IDF rooms being preferred.

K. Electric power supplies and power converters for the access system equipment and hardware shall be connected in the Telecommunications/IDF room. Power supplies located at the access equipped door should be avoided.

L. Electrical service to access control power supplies shall be on dedicated circuits. Where practicable, electric power for the access system should be provided through the building emergency power supply.

M. All access control equipment power supplies shall be equipped with battery back up to allow operation if electrical service and emergency generated power is lost.

N. As a minimum, provide conduit from all access devices, hardware, and equipment to ceiling location to allow for convenient access to raceways for cabling.

O. All new construction installation of access control systems shall be hardwired. In renovation or retro-fit installations hardwired installations are preferred; wireless systems may be considered with the approval of Access Services, and Project Manager, and building owner.

P. Wiring Connection Requirements: All low voltage control, monitor, power, and other cables shall be connected using sealed crimp type lugs, no wire nuts will be allowed.

Q. Monitor Contacts: Door monitoring contacts, and wiring and conduits there to, shall be concealed and invisible when the door is closed. Externally applied door monitoring contacts, externally applied conduit or wire mold, and wire without conduit must be approved by Access Services, Project Manager, and building owner.

R. Request to Exit Switches: Request to exit (RX) switches should be mechanically hardware based devices. Passive infrared (PIR) or sonic detectors should only be used when no mechanical method is available.

3.2 CONDUCTORS, WIRE, CABLES

A. Data

1. All access control system data wiring, cables, jumpers, and connectors will comply with requirements of Section 27 01 00 Communication construction standards.

B. Low Voltage Electrical

1. All access control system low voltage electrical wiring, cables, and connectors will comply with the requirements of Section 27 01 00 Communication construction standards.
2. All access control system low voltage electrical wire shall be rated and adequate to supply the intended doors full functionality including but not limited to lock mechanisms, readers, and monitoring points without exceeding seventy-five percent (75%) of the wire’s rated capacity
3. Distance from power supply to door lock should be examined to determine correct wire gauge to support expected voltage drop over distance.

3.3 CONTROLLERS

A. Squadrons / Controllers

1. All access control system squadrons and/or controllers should be located in secure location with Telecommunication / IDF closets being preferred.
2. All access control system controllers and interface devices shall be housed in a metal case capable of being locked.
3. All access control system squadron and/or controller installations shall comply with requirements of Section 27 01 00 Communication construction standards.

B. Wireless Controllers and Transceivers.

1. All access control system wireless transceivers / PIMs shall be mounted out of the public view with mounting in a secured room being preferred.
2. All access control system wireless transceivers/PIMs shall be housed in a metal case capable of being locked.
3. All access control system wireless transceivers/PIMs installations shall comply with requirements of Section 27 01 00 Communication construction standards. Attention should be given to avoid other equipment which might interfere with the proper operation of the squadrons and/ or controllers.

3.4 ELECTRICAL POWER NEEDS

1. All access control system power supplies should be located in secure location with Telecommunication / IDF closets being preferred.
2. Access control power cables shall not be installed to be within the public view. Any power cables within public view shall be placed in conduit to prevent damage or tampering.
3. All access control power supplies shall be rated and adequate to supply all controllers, door locks, card readers, and monitor devices without exceeding seventy-five percent (75%) of the power supply. In selection of power supply output, special attention should be paid to expected distance from power supply to door installation and resulting voltage drop over distance
4. Access control power supplies should be equipped with battery back up to insure operation in the event of power failure.
5. Access control power supplies should be connected to the buildings emergency power system to insure service in the event of a power failure.
6. Access control power supplies shall be equipped to allow access system to detect and report building electrical power feed failure.
7. Access control power supplies shall provide a device or method to terminate building electrical power feed at the power supply by switch or plug.
8. A four gang electrical outlet connected to dedicated 20 amp power supply shall be provided at each controller/power supply installation location.

3.5 EQUIPMENT CABINETS

A. All access control system controllers and power supplies shall be housed in metal cabinets capable of being locked using a key. The cabinet shall be secured to the wall of the telecommunication /IDF closet. The final mounting location in telecommunication closet/IDF closet requires prior approval by the Office of Technology Resources.

B. All access control system controller and power supplies cabinets shall be equipped with monitors to allow remote determination of cabinet cover door status (open vs closed).

C. Conduit wire pathways shall be installed to house wiring passing from the power supply cabinets and the squadron/controller enclosures.

3.6 ELECTRONIC ACCESS CONTROL AND VIDEO SURVEILLANCE ADMINISTRATION

A. Administration of the electronic access control infrastructure includes documentation of devices, cables, termination hardware, patching and cross-connection facilities, conduits, other cable pathways, and telecommunications closets.

3.7 RECORDS

A. A record is a collection of information about or related to a specific element of the access control system. Records must be maintained in a computer printable spreadsheet, or in a computer database. Paper records are encouraged, but are optional. A device and cable record is prepared for each device/door installation. The record will show the device/door name, and must describe the components from origin point and destination point. The device and cable record will record what services and/or connections are assigned to each installed location based on Equipped Door Number. An equipment record is prepared for services distributed from a certain piece of equipment, such as a encoder, controller, or a system.

3.8 DRAWINGS

A. Drawings are used to illustrate different stages of access control system installation planning, installation, and administration.

B. Installation or Construction Drawings

1. Installation or construction drawings are the plans that show the installer how the infrastructure and devices are to be installed. The quality of the installation can be directly impacted by the level of detail in the installation drawings and written specifications. Installation drawings shall, at a minimum, device installation, show pathway locations and routing, configuration of access control systems including door hardware installation, device installation, infrastructure, backboard and equipment rack configurations, and wiring details include identifier assignments.

C. As-built Drawings

1. The as-built drawings graphically document the installed access control infrastructure through floor plan, elevation, and detail drawings. In many cases, these drawings will differ from the installation drawings because of changes made during construction and specific site conditions. In the as-built drawings, the identifiers for major infrastructure components must be recorded. The pathways, spaces, and wiring portions of the infrastructure each may have separate drawings if warranted by the complexity of the installation, or the scale of the drawings. As- built drawings are a vital component of the administration system, and must be kept current as adds, moves, and changes take place

3.9 LABELING AND COLOR CODING

A. It is important that both labeling and color coding be applied to all access control devices, wiring, and infrastructure components. Labeling with the unique identifier will identify a particular component.

Proper color coding will quickly identify how that component is used in the overall systems infrastructure of the facility.

B. Labeling

1. Labels shall be applied to the wiring terminations and corresponding devices. Wiring and cable labels shall be applied at the doorway end and controller device side of cable and wiring runs.
2. Labels are generally of either the adhesive or insert type. All labels must be legible, resistant to defacement, and maintain adhesion to the application surface.
3. Outside plant labels shall be totally waterproof, even when submerged.
4. All labels shall be machine printed.
5. Labels applied directly to a cable shall have a clear vinyl wrapping applied over the label and around the cable to permanently affix the label.
6. Other types of labels, such as tie-on labels, may be used. However, the label must be appropriate for the environment in which it is used, and must be used in the manner intended by the manufacturer.

C. Color Coding – Cable Termination Fields

1. Color coding shall be applied to all cables and cable termination fields in Telecommunications Closets, Equipment Rooms, and Entrance Facilities. Color coding may also be used to identify specific cables in a pathway, or the function of specific equipment racks or equipment. The same color is always applied to both ends of any given cable. Cross-connections are generally made between termination fields of different colors. The color may be applied to the plywood backboard behind the termination block, may be the color of a plastic cover on a termination block, or may be the actual color of the insert label on a termination block or patch panel. See Communications 27 05 28 1.01 A Construction Standards.

END OF SECTION 28 13 00

SECTION 28 23 00 - VIDEO SURVEILLANCE SYSTEM

PART 1 - - GENERAL

1.1 SUMMARY

A. Related Sections

1. 281300 – Electronic Access Control
2. 271000 – Telecommunications Structured Cabling
3. 272000 – Local Area Network Electronics

B. System Requirements

1. Provide and install video surveillance cameras, hardware, head-end equipment, power supplies, UPSs, lightning protection, server/client software, licenses, related security hardware and Owner Furnished NVRs as specified and as detailed in associated contract drawings.
2. Integrate existing video cameras, system hardware, software, licenses, and locations to provide a full functioning and complete video surveillance system.

1.2 REFERENCES

A. The Codes and Regulations listed below form a part of this specification to the extent referenced. Work shall be performed in accordance with the applicable international, federal, state, and local codes or standards current at the commencement of installation. The following list summarizes applicable standards:

1. UL 294, UL 1076, ULC
2. CE
3. FCC – Part 15, Part 68
4. NFPA 70, NEC
5. IEEE, RS 170 variable standard

B. Where more than one code or regulation is applicable, the more stringent shall apply.

C. Cable and equipment installation, identification and termination shall be performed in accordance to the applicable codes above.

1.3 DEFINITIONS

A. ADA: Americans with Disabilities Act

B. Bid: Herein, used interchangeably with “proposal”

C. CATV: Central or Master Antenna Television (broadband)

D. Demarc: “Demarcation Point” marking the location where communications facilities owned by one organization interface with that of another.

E. DVR: Digital Video Recorder

F. GUI: Graphical User Interface

G. LAN: Local Area Network

H. IP: Internet Protocol

I. IR: Infrared

J. NIC: material and work which is Not In Contract and for which the Installer is not responsible except as otherwise detailed herein.

K. NVR: Network Video Recorder

L. OFE: “Owner Furnished Equipment” which will be provided by The Owner. Be responsible for installing and integrating this equipment as detailed herein.

M. OFCI: “Owner Furnished Contractor Installed” Equipment which will be provided by The Owner. Be responsible for installing and integrating this equipment as detailed herein.

N. OSP: Outside Service Plant

O. PoE: Power over Ethernet

P. SAN: Storage Area Network

Q. TR: Telecommunications Room

R. UPS: Uninterruptable Power Supply

S. The term “shall” is mandatory.

T. The term “will” is informative.

U. The term “should” is advisory.

V. Term “provide” means furnish and install.

W. Security Consultant: Convergent Technologies Design Group, Inc.

X. Bidder: Qualified firm intending to tender a bid on the systems described herein.

Y. Owner: Delaware Technical & Community College (herein referred to as “DTCC”)

Z. Construction Manager (CM) or General Contractor (GC): The representative responsible for general building construction and onsite coordination between sub-contractors

1.4 BID PROPOSALS

A. Itemized Bid Response

1. Each piece of equipment shall be individually priced and submitted with Bid Proposals. Provide itemized bid response to include equipment description, manufacturer, model number, unit price, and quantity. All equipment prices shall reflect required modifications and accessories as needed for a complete and functioning system.
2. Non-equipment charges shall be outlined separately as a single line item. A sum of the video surveillance system total cost shall be provided with the bid proposal.
3. Lump sum bids will not be accepted.

B. Contractor Qualification

1. Demonstrate at least three (3) years experience in the fabrication, programming, assembly, and installation of video surveillance systems of similar magnitude and quality as specified for the subject job. Submit documentation to this effect with the bid response. Be an authorized sales and service center for all listed components and offerings in this specification.
2. References: Furnish no less than three (3) references for installations of similar size (dollar amount & quantity of spaces receiving integrated technology) and scope, performed throughout Dover, Delaware area within the past three (3) years. At a minimum, reference information will include the reference company or institute name, contact person's name and title, telephone number, address, and detailed project description, project manager's name, and contact information of the organization that is responsible for day-to-day operation of the video surveillance installation.
3. Bidders shall include as part of the bid response the following items:

    a. List of all technical personnel factory-certified on Honeywell security products.
    b. Letter of approval from the manufactures indicating compliance with qualification requirements.
    c. Installation schedule with proposed manpower assignments,
    d. Resumes for project manager, lead engineer and certification of NICET Video Security System Technician Level 4, as well as ASIS CPP certifications for this project.
    e. Training certificates for design, engineering and installation of the proposed products shall be submitted with the proposal.
    f. Service Dispatch outline containing the type of service program used for dispatching and tracking service calls.

C. Alternate Proposals

1. Any proposed alternate equipment choices should be requested in writing prior to the proposal submission for approval. Each item on the alternate equipment list must be accompanied by catalog cut sheets and technical specifications.

D. Non-Equipment Charges, Including but not be limited to:

1. Engineering: Including all required design drawings, run sheets, instruction manuals, console layout, step-by-step user guide, etc.
2. Pre-Installation: Work performed on the Installer's premises including all fabrication, modification, assembly, rack wiring, etc.
3. Installation: Including all on-site installation and wiring, shop drawing, coordination and supervision, testing, checkout, Owner training, etc., performed on the Owner's premises.
4. General and Administrative: Including all shipping, insurance, and guarantees.

E. Owner Furnished Equipment (OFE, OFCI)

1. Identify any Owner Furnished Equipment assumed in the Bid Proposal to be installed and integrated under this contract. Identify all assumed Owner Furnished equipment within each room/space type that will be required to complete the Video Surveillance systems installation.

F. State of the Art Development

1. Supply only the manufacturer's latest developed product. In cases where product development surpasses the criteria of the specification, inform the Architect and make the newer product available to the project at no additional cost. In no case shall discontinued or obsolete equipment be acceptable. The same requirement applies to software programs developed/updated during the warranty period.
2. Should a manufacturer discontinue a specified product, provide the manufacturer's recommended replacement at no additional cost to the owner. Should the manufacturer have no direct replacement product, the video surveillance contractor shall propose a product of equal or greater specification from an alternate manufacturer at no additional cost to the owner.
3. Should a product recall by a specified manufacturer require temporary or permanent replacement of a product specified under this section, notify the Architect at the earliest possible time and arrange to replace the product in question as quickly as possible.

    a. Equipment found defective or subject to recall prior to scheduled installation shall not be delivered to the jobsite.
    b. Equipment defect or intended recall shall not relieve the video surveillance contractor from any contractual obligations with regard to delivery schedule of product.
    c. Under no circumstances shall arrangement for alternate product require the Owner to accept superseded equipment except on a temporary basis.

G. Service Contract

1. Submit the costs for a one-year service contract, renewable for up to three years, which shall commence with the completion of the two-year warranty period. These contracts shall be fixed-cost, and can be accepted at the option of the Owner.
2. The service contract shall include all of the services provided during the warranty period, including complete replacement or repair of defective equipment.

1.5 QUALITY ASSURANCE

A. Coordination

1. 281300 for integration requirements of Access Control, video surveillance of doors, triggers, alarms, and software integration.
2. 271000 for pathways, cabling locations, colors, termination ports, and all OSP Demarc locations related to video surveillance systems.
3. Test and verify structured cabling installed to support the video surveillance system.
4. Coordinate layout and installation of Video Surveillance Systems equipment with Owner's security representative.

    a. Meet jointly with Owner to exchange information and agree on details of equipment arrangements and installation interfaces, as well as integration into the existing Video Surveillance system.
    b. Record agreements reached in meetings and distribute them to other participants and the Architect for design team distribution.

5. Coordinate this Section with work of other Project Manual sections and associated trades.
6. Specific references, herein, requiring coordination of certain work shall not obviate responsibility for other required coordination.

B. Unspecified Equipment and Material

1. All equipment and materials not specifically addressed on the drawings or in this document and required to provide complete and functional video surveillance system shall be provided in a level of quality consistent with other specified items.

C. Standards and Codes

1. Comply with

    a. Local, state and federal codes
    b. Applicable National Electrical Code
    c. American National Standards Institute
    d. Underwriters' Laboratories, Inc. standards.

2. All equipment, material, accessories, and loose items provided by Contractor shall be new and shall conform to applicable requirements of the above-mentioned agencies.
3. If required by local authorities, provide certificates and labels indicating compliance with above-mentioned codes and standards where applicable.

D. Point of Contact

1. Designate to the Owner in writing, the responsible person who shall ensure timely and consistent communication with the Owner on progress of the contract. The designated representative shall have full knowledge of all engineering and production procedures and shall report status of the installation and upcoming work plans to the Owner's Project Manager and Consultant on a weekly basis.

2. Project manager shall have successfully managed not less than two (2) projects of similar size and scope (as defined in previous sections). Bid submission shall detail the percentage of time that the project manager and other key personnel will be involved with the project.

1.6 SCOPE OF WORK

A. Provide the following in accordance with Specifications and Drawings

1. Submittals delivered in a timely manner as described hereinafter.
2. Verification of dimensions and other conditions at project site. Review conduit system as shown in electrical section of building construction documents and, where applicable, as built conditions. Notify Consultant, Architect, GC, and EC within four weeks after award of contract of any deficiencies or inadequacies in conduit system design.
3. Detailed design of surveillance system GUI, system "maps," including remote-control accommodations.
4. Power distribution and battery backup within equipment racks and wall fields including power connection to electrical outlets as described in electrical section of building construction documents.
5. Incidentals necessary for a complete working system.
6. Initial testing and adjustments, demonstration of system for approval, participation in acceptance tests, final adjustments as required.
7. Record Documents, "As-Built" drawings and Owners Manual.
8. Training of operating personnel.
9. Notify appropriate parties of conflicts in a timely manner.
10. Work cooperatively with other trades to resolve conflicts.

B. Special Insurance

1. Provide insurance fully covering all equipment against loss, damage, and theft during shipment, storage, installation, testing, adjustment and demonstration.

1.7 SYSTEM DESCRIPTION

A. DTCC currently uses Honeywell IP based surveillance cameras with network video recording equipment integrated by Advantech (www.advantechsecurity.net).

B. All video surveillance or documentation systems shall be recorded and stored using the current network-based video surveillance monitoring and control system and administered by DTCC.

C. Design Intent

1. Provide a complete and functioning video surveillance system inclusive of all hardware, software engineering, programming and training to meet or exceed the performance features outlined in this document.

D. Design Standards

1. All video camera systems shall be systems, equipment, and accessories fully compatible and integrated with the current networked video surveillance system.
2. All additional accessories or supporting hardware shall be fully compatible with and able to integrate with existing campus systems.
3. Video surveillance systems shall be installed to in compliance with Federal Law, State Law, and DTCC policies.
4. All video surveillance installations shall provide adequate housings and environmental controls to insure proper operation of cameras determined by environmental conditions and building usage. Provide protection from accidental and intentional damage or tampering. Torx with center pin security fasteners shall be used for devices in public areas.
5. All video surveillance installations shall be overt using housings and mountings which maintain or minimize disruption to architectural sensibilities or themes of the buildings and campus. No hidden or covert video surveillance systems shall be installed without prior written permission and approval of the DTCC Security Representatives.
6. Cameras using optical/mechanical pan, tilt, zoom systems are preferred to digital pan, tilt, zoom systems. Digital pan, tilt, zoom systems require the approval of building owner and the DTCC Security Representatives.
7. Buildings that have exterior entrances and/ or interior doors, interior areas, parking lots or external areas equipped with a video surveillance system shall be equipped with signage announcing the use of video surveillance equipment be displayed on doors or entrances.

E. Installations of video surveillance system equipment hardware shall comply with requirements in DTCC construction standards.

F. All equipment and components to support video surveillance system shall be installed to manufacturer's specifications. Installation of components and hardware shall be in place prior to connection to the video surveillance system.

G. Where practical the electric power for the video surveillance system equipment and hardware shall be connected through the building emergency power system or provided with appropriate battery backup systems.

H. Exterior mounted cameras should be appropriately protected from lightning strikes.

I. The final building video surveillance system shall be approved by the Supervisor of the University's Public Safety Communications Center.

1.8 SUBMITTALS

A. Related Sections

1. Comply with requirements of Section 01 33 00 - Submittal Procedures.

B. Submittal Data

1. Submittal data is to be submitted in a three ring binder, a continuous spiral binder, or plastic binding that allows the booklet to lie flat while open. Each booklet shall contain the below in the following order:

a. Cover Sheet.

1) Include name of supplying contractor and project name.

b. Detailed Bill of Materials.

1) Include a listing of: component quantities, equipment manufacturers, model numbers, and description of each component being supplied, and the specification paragraph or drawing sheet that corresponds to the product. Failure to provide this information will result in the rejection of submittals.

c. Product Data.

1) Include a catalog sheet per product of equipment listed in the Detailed Bill of Materials, in the exact order as the Detailed Bill of Materials. Each catalog sheet shall describe mechanical, electrical and functional equipment specifications. The catalog sheet must also include an image of the product. Photocopy duplications of the manufacturer's original equipment catalog sheets will be allowed as long as they provide adequate clarity of both the printed word and graphics/pictures. If more than one product is shown on the catalog sheet the intended product must be denoted by either an arrow or highlight.

d. Authorized Distributor Certificate.

1) Recently dated (within one year from submittal date) support letter from manufacturer stating that the supplying contractor is an Authorized Distributor of the product being supplied.

C. Shop Drawings

1. Prior to fabrication submit contractor generated drawings for approval for all supplied systems. These drawings shall include, but are not limited to, the following:

a. Title Sheet & Symbols Legend
b. Riser Diagram: Show the relationship of TR's, the pathway between them, and cable connectivity to be installed.
c. Telecommunications Room Details: Elevation Details of wall fields and rack details showing the relationship of rack mounted elements inclusive of Owner provided equipment (labeled as such).
d. All panels, plates, and designation strips, including details relating to terminology, engraving, finish and color.
e. All equipment racks, cabinets, consoles, tables, carts, support bases, and shelves.
f. Schematic drawings (Video Surveillance), system functional block drawings. Resubmission of contract drawings is unacceptable.
g. All unusual equipment modifications.
h. Front mechanical drawings of each equipment rack.
i. Equipment location drawings.
j. Cable labeling plan.

k. Floor Plans, RCPs and Elevations: Show planned location for all elements and cable routing. Drawings should be at project standard scale and clearly legible.

D. Form

1. Submit all materials for review as described above, specifically referenced to the Specification paragraph number (where applicable).

   a. Submit all drawings on sheets of one size, preferably the project standard size.
   b. Where materials are presented on sheets 11” x 17” or smaller, organize into three-ring binder which include:

      1) Dividers or tabs between logical sections
      2) Project name and binder title labels on face and edge of binders

   c. On submittal drawings, maintain 3/32” minimum lettering height. Submittals with text less than 1/16” in height may be rejected.

2. Partial Submittals may be rejected. If submitted individually and each in its entirety, the following Submittals shall not be considered partial:

   a. Personnel
   b. Milestones
   c. Conduit Verification Statement and Notifications
   d. Rigging and Mounting Drawings
   e. As-Built Documentation

3. Product Data and Shop drawings must be submitted together in order to be reviewed.

E. Weekly Reporting

1. Commencing with project award, provide weekly status reporting of milestone task status, anticipated completion date, and related memo notes for the following tasks:

   a. Submittals
   b. Infrastructure verification
   c. Pre-wire status
   d. Equipment Procurement
   e. Shop fabrication
   f. Remote control system design
   g. Installation and Terminations
   h. Field testing and pre-acceptance testing
   i. Final acceptance demonstrations
   j. Owner training
   k. First owner use
   l. Open Coordination Items and Questions

2. See below for a partial example of an acceptable weekly reporting list.

Project:	*Project Name*			
Location:	*Project Location*		Date:	*Form Delivery Date*
Project Manager:	*Project Manager*		Delivered by:	*Form Delivered By*

		Projected Completion:	Status:	Notes:
Infrastructure Verification:		*6/1/2012*	*Complete*	
Submittals:				
	Product Data	*8/1/2012*	*Complete*	
	Drawings	*8/1/2012*	*Complete*	
	Personnel (etc.)	*8/1/2012*	*Complete*	
RFIs:				
	12	*8/25/2012*	*Received*	*Implementing*
	178	*9/6/2012*	*Pending*	*Camera Installation Hardware*

Installation Status by Space

Room			Equipment				
Name	Number	Pre-Wire	Order	Receive	Install	Test	Notes:
Example 1	*105*	*100%*	*100%*	*100%*	*60%*	*0%*	*Re-programming*
Example 2	*135*	*100%*	*100%*	*100%*	*90%*	*0%*	*Other Notes Here*

F. Personnel

1. Provide, in writing, within two weeks after award of Contract, the names, mailing address, phone numbers with extensions, email addresses and paging service numbers (if available) of the following project personnel:

   a. Project Manager
   b. Lead Systems Engineer
   c. Field Foreman

G. Conduit Verification

1. Within four weeks after award of Contract, submit statement confirming that Contractor has reviewed the conduit system as designed in building construction documents and, where applicable, as built.
2. Notify Consultant, General Contractor, Architect or Electrical Contractor of deficiencies or inadequacies, if any, in conduit system design or installation. If none, so indicate.
3. Absent conduit verification by Contractor and after installation of conduit as designed, Contractor shall assume costs of equipment, materials, labor and engineering, including services of owner's representative(s) in designing and/or verifying revised wiring approach(es) as relate to providing a fully functional system using conduit as designed or as revised at the discretion of the owner.

H. Rigging and Mounting Drawings

1. Submit full size drawings outlining mounting and installation details of all video surveillance equipment requiring integration with cabinetry or architectural elements.

2. Details, stamped and signed by an appropriately licensed engineer, of all equipment mounting methods and materials provided by the Scope of Work, wherein failure of method or materials used for mounting or hanging permanently installed equipment could result in serious personal injury.

    a. Details provided by or requiring approval by licensed engineer may include: method of attachment to building structure or attachment and/or suspension points; method of attachment to supported equipment; all suspension materials; a materials list including specifications of all suspension materials; calculations used to determine loads and strengths of suspension materials, other as deemed necessary by the engineer.

3. In the absence of submitted approved, stamped and signed mounting and hanging details, the Owner reserves the right to acquire such engineering approval at the expense of the Contractor. Owner will notify Contractor of such intent. Contractor shall remedy within two weeks or Owner may proceed without Contractor approval and without relieving Contractor from any other obligations set forth by Contract.

I. Color Selection

1. Color options for all items as applicable.
2. Camera finishes should be coordinated with the Architect.

1.9 CLOSEOUT SUBMITTALS

A. At the completion of the installation, but before Final Acceptance, provide for review and approval the following, in compliance with Division 1 Section *Closeout Procedures*.

1. Operation and Maintenance Manuals:

    a. Equipment manufacturer's operation and service manuals for each make and model of equipment.
    b. System Operation Manual. Produce a manual specifically for the subsystems detailed herein. The manual shall describe all procedures necessary to activate each system to provide for the functional requirements, except as specifically excluded by the Owner. This section shall provide a simple "How-to" users guide for the procedures needed to operate the system. This document shall contain a section on operating the systems equipment in the event of control system failure. Control system touch panel layouts shall be accompanied by narrative text describing "step-by-step" function engagement.

B. Warranty

1. Provide list and dates of activation of equipment warranties
2. Provide original manufacturers' certificates.

C. As-built Drawings

1. Include contractor generated (mark-up of contract documents is not acceptable) digital record diagrams for all systems including, but not limited to:

    a. Schematic wiring diagrams with cable markings.
    b. Internal wiring diagrams of the equipment rack cabinets.
    c. Custom equipment modifications.
    d. Final test results and nominal settings for all adjustable controls.

D. Software Passwords

1. Software Passwords Schedule (i.e., a spreadsheet listing the manufacturer, model number and location in the Facility, of each piece of video surveillance equipment, the software for which is password-protected).
2. Provide to Owner's Representative as a secure document separate from Operating and Maintenance Manuals and As-Built Drawings.

E. Laminated Instruction Cards

1. Provide 8 ½ x 11 Instruction cards, approved by the Owner. Laminate step-by-step instructions outlining system operations for the video surveillance system. Provide editable file of card to Owner.

1.10 SUBSTITUTIONS AND QUALITY:

A. Where products are specified by name, provide and install that product. Substitutions will not be accepted for the video surveillance system or their sub-systems.

1.11 DELIVERY, STORAGE, HANDLING, AND STAGING

A. Supply, transport, deliver, unload, move to the installation location, unpack, place, assemble, secure, connect, and install all equipment needed to complete the installation. Be responsible for transportation, parking, delivery, and on-site storage of the system's equipment. Be responsible for all transportation of personnel to and from the site.

B. Reconfirm before delivery that hallways, stairways, passages, doorways, rooms, entries, elevators and foyers are of sufficient size to accommodate the passage and installation of the equipment and systems. Off-site pre-staging of goods is encouraged.

C. The Owner's acknowledgment of delivery of goods and any payment made on account of such delivery shall not constitute acceptance (partial or otherwise) and shall not diminish obligations as specified.

D. The actual dates of delivery shall be under the absolute control of the Owner. The dates and times for delivery/installation are critical to the successful completion of the project. Deliveries shall normally be accepted only approved work hours. In the event it becomes necessary for goods to be installed outside these hours comply with the instructions of the Owner. Deliveries attempted outside these hours without prior consent of the Owner may be turned away. Comply with all instructions of the Owner and the Contractor concerning time of arrival at the site;

which entrance shall be utilized for delivery; routes to be taken to reach the installation location; and other matters relating to the orderly and timely installation of the system.

E. Installation shall commence immediately upon delivery of materials to the jobsite, except as directed by Construction Manager. Time required from delivery date to completion of project shall be in accordance with the approved schedules.

F. Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

G. Do not deliver or install equipment until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.12 WARRANTY

A. The system warranty shall be for twenty-four (24) months from the date of final acceptance. Provide all equipment, material, and labor required to uphold a full system warranty at no charge to the Owner. All manufacturers' equipment warranties shall be activated in the Owner's name and shall commence on the date of final acceptance. In the case of modified equipment, the manufacturer's warranty is normally voided. In such cases, provide the Owner with a warranty equivalent to that of the original manufacturer.

B. There shall be no cost to the Owner for maintenance performed during the warranty period beyond the fixed cost of the contract.

C. Provide a total of eight (8) one-day visits per year, or a total of sixty-four (64) engineering/ service labor hours, specifically to conduct preventive maintenance and implement Owner directed system adjustments.

D. Repair and/or adjust any malfunctioning components located by the technician. Include system programming updates and modifications as part of this service contract, providing an updated editable copy of the source code to the Owner.

E. Provide a service telephone number, staffed by a qualified technician familiar with the equipment installed. Staff this number during normal business hours.

F. Respond with an on-site technician within 24-hours of a service call (including Saturdays and Sundays) for all equipment and system failures.

G. Replace or repair, at no cost to the owner, any failed equipment hardware or software installations required to provide full system operations.

H. During the warranty period, advise the Owner in writing each time any routine software and firmware updates become available, giving the Owner the opportunity to upgrade the software/hardware should they so desire at no additional cost. Provide any necessary system modifications after installation of these updates to maintain a fully functioning system.

I. Provide updates to firmware during service period. Provide any necessary system modifications after installation of these updates to maintain a fully functioning system.

J. The warranty period for any part which has a warranty by the manufacturer of longer than 24 months shall be for the longer period. Provide a copy of the manufacturer's warranty period statement for all major CCTV components.

K. Any item failing before the two year guarantee period expires shall be replaced and the guarantee extended for that item for twelve months from the replacement date of the item.

PART 2 - PRODUCTS

2.1 WIRING AND CABLING

A. Data transmission cable.

1. All video surveillance system data wiring, cables, jumpers, and connectors will comply with requirements of Section 27 10 00 Communication construction standards.

B. Low voltage electrical wiring.

1. All video surveillance system low voltage electrical wiring, cables, and connectors will comply with the requirements of Section 27 10 00 Communication construction standards.
2. All video surveillance system low voltage electrical wire shall be rated and adequate to supply the intended cameras full functionality including but not limited to camera operations, audio equipment, mechanical movement, and environmental housing without exceeding seventy-five percent (75%) of the wire's rated capacity.
3. Sufficient cabling should be provided to each camera to use all audio, dry contact input and output capabilities of the camera.

2.2 ELECTRICAL POWER NEEDS

A. Video surveillance power supplies should be located in Telecommunication / IDF closets.

B. Video surveillance system power cables shall not be installed to be within the public view. Any power cables within public view shall be placed in conduit to prevent damage or tampering.

C. Video surveillance camera power supplies shall be equipped with battery back up to insure operation in the event of power failure.

D. Video surveillance power supplies shall be connected to the buildings emergency power system to insure service in the event of a power failure.

E. Power over Ethernet (PoE) power distribution to video cameras shall be utilized for all fixed camera locations, PTZ and exterior cameras with heaters will require PoE+/High PoE.

F. Remote Exterior cameras requiring optical fiber runs shall be powered by AC.

2.3 MOUNTING EQUIPMENT

A. All video surveillance cameras housings and mounts adequate to provide protection against accidental and intentional damage or tampering. Torx center pin security fasteners shall be used on devices in public areas.

B. All video surveillance camera housings and mounts shall have adequate housings and environmental controls to insure proper operation of camera as determined by environmental conditions and building usage.

C. All video surveillance installations shall be overt using housings and mountings which maintain or minimize disruption to architectural sensibilities and themes of the building and campus.

2.4 DATA TRANSMISSION RESOURCES NEEDS

A. Work closely with the DTCC IT/Technology offices to insure adequate computer network resources are available for intended additions to the DTCC video surveillance systems.

B. Data cable runs shall be limit to no more than 290 ft from the camera device and switch. During design and installation close attention should be paid to the distance of cabling runs for video surveillance.

C. Camera installations requiring cable runs longer than 290 ft shall use coaxial cable to transmit video signal to a digital encoder located in the telecommunications/IDF closets.

D. Camera installations at remote exterior locations shall use optical fiber with UTP/optical fiber transceivers to transmit video signals to the telecommunications/IDF closets.

E. All data transmissions between cameras and recording servers or devices shall be encrypted or made on secure network pathways to ensure data cannot be intercepted or manipulated.

2.5 CAMERA REQUIREMENTS

A. All cameras shall provide a minimum resolution, dynamic range, and field of view to provide clear and crisp images to the Owners satisfaction.

B. Exterior Cameras

1. Day/Night Fixed Network Camera

- 1/3” progressive scan CCD, 4CIF Resolution
- Autofocus, automatic day/night
- MPEG-4 compression
- Remote firmware updates
- 12VDC or PoE IEEE 802.3af power inputs

- Supports IPv4 network protocols

Product: Honeywell HCD 554IP network camera

2.6 HEAD-END REQUIREMENTS

A. Provide all cabling, connections, software, programming, and licensing necessary to fully integrate all existing refurbished and new video cameras into the existing DTCC video surveillance monitoring and control software.

B. Existing systems integration completed by Advantech Incorporated.

PART 3 - EXECUTION

3.1 EXAMINATION.

A. Shall examine areas and conditions under which the equipment is to be installed and shall notify the general contractor in writing of conditions detrimental to proper and timely completion of work.

3.2 VIDEO SURVEILLANCE ADMINISTRATION

A. Administration of the video surveillance infrastructure includes documentation of devices, cables, termination hardware, patching and cross-connection facilities, conduits, other cable pathways, and telecommunications closets. All DTCC facilities shall apply and maintain a system for documenting and administering the electronic access control infrastructure.

B. All video surveillance cameras, devices, and cables shall be clearly marked using permanent means. Conform to DTCC video surveillance labeling and administration standards.

3.3 RECORDS

A. A record is a collection of information about or related to a specific element of the video surveillance system. Records must be maintained in a computer spreadsheet, or in a computer database. Paper records are encouraged, but are optional. A device and cable record is prepared for each camera/device/door installation. The record will show the camera/ device/door name, and must describe the components from origin point and destination point. The device and cable record will record what services and/or connections are assigned to each installed location based on Camera number. An equipment record is prepared for services distributed from a certain piece of equipment, such as a encoder, controller, or a system.

3.4 DRAWINGS

A. Drawings are used to illustrate different stages of video surveillance system installation planning, installation, and administration.

B. Installation or Construction Drawings

1. Installation or construction drawings are the plans that show the installer how the infrastructure and devices are to be installed. The quality of the installation can be directly impacted by the level of detail in the installation drawings and written specifications. Installation drawings for DTCC projects shall, at a minimum, device installation, show pathway locations and routing, configuration of telecommunications spaces including backboard and equipment rack configurations, and wiring details including identifier assignments.

C. As-built Drawings

1. The as-built drawings graphically document the installed video surveillance devices and infrastructure through floor plan, elevation, and detail drawings. In many cases, these drawings will differ from the installation drawings because of changes made during construction and specific site conditions. In the as-built drawings, the identifiers for major infrastructure components must be recorded. The pathways, spaces, and wiring portions of the infrastructure each may have separate drawings if warranted by the complexity of the installation, or the scale of the drawings. As- built drawings are a vital component of the administration system, and must be kept current as adds, moves, and changes take place.

3.5 LABELING AND COLOR CODING

A. It is important that both labeling and color coding be applied to all video infrastructure components. Labeling with the unique identifier will identify a particular component. Proper color coding will quickly identify how that component is used in the overall systems infrastructure of the facility.

B. Labeling

1. Labels are generally of either the adhesive or insert type. All labels must be legible, resistant to defacement, and maintain adhesion to the application surface.
2. Outside plant labels shall be totally waterproof, even when submerged.
3. All labels shall be machine printed.
4. Labels applied directly to a cable shall have a clear vinyl wrapping applied over the label and around the cable to permanently affix the label.
5. Other types of labels, such as tie-on labels, may be used. However, the label must be appropriate for the environment in which it is used, and must be used in the manner intended by the manufacture.

C. Color Coding – Cable Termination Fields

1. Color coding shall be applied to all cable termination fields in Telecommunications Closets, Equipment Rooms, and Entrance Facilities. Color coding may also be used to identify specific cables in a pathway, or the function of specific equipment racks or equipment. The same color is always applied to both ends of any given cable. Cross-connections are generally made between termination fields of different colors. The color may be applied to the plywood backboard behind the termination block, may be the color

of a plastic cover on a termination block, or may be the actual color of the insert label on a termination block or patch panel. See Communications 27 05 28 1.01 A Construction Standards.

END OF SECTION 28 23 00

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Protecting existing trees, shrubs, plants and grass to remain.
2. Removing existing trees and other vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and abandoning site utilities in place and removing site utilities.
7. Temporary erosion and sedimentation control measures.

B. Related Sections include the following:

1. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
2. Division 32 Section "Turf and Grasses" for finish grading including preparing and placing planting soil mixes and testing of topsoil material.

1.3 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

1.6 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

C. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earth Moving."

1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to approved Sediment and Erosion Control Drawings.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE PROTECTION

A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.

1. Do not store construction materials, debris, or excavated material within fenced area.
2. Do not permit vehicles, equipment, or foot traffic within fenced area.
3. Maintain fenced area free of weeds and trash.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

1. Employ an arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
2. Replace trees that cannot be repaired and restored to full-growth status, as determined by Architect.

3.4 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. The Owner will arrange to shut off indicated on-site utilities when requested by Contractor.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Construction Manger and Owner not less than five days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner’s written permission.

C. Excavate for and remove underground utilities indicated to be removed. Refer to sections covering site utilities.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
4. Use only hand methods for grubbing within tree protection zone.
5. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Do not stockpile topsoil within tree protection zones.
2. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing, full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.8 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 311000

SECTION 312000 – EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The General Conditions, any Supplementary General Conditions and Division 1, General Requirements, are hereby made a part of this Section as fully as if repeated herein.

1.2 SECTION INCLUDES

A. Earthwork includes areas below building foundations, below concrete slabs on grade, below paved areas and grading of all unpaved area in the site.

1. Layout and staking for earthwork.
2. Excavation and rough grading.
3. Erosion and sediment control.
4. Foundation excavation for footings.
5. Establishing subgrades, leveling and proofrolling.
6. Filling, backfilling and compaction.
7. Keeping streets clean of materials tracked off site.
8. Includes trenching, excavation and backfill for utilities.
9. Maintenance and/or repair of damage to the rough grading.
10. Removal and disposal of stones, debris, excess and unsuitable materials.
11. Soil treatment for termite control.
12. Field quality control, testing, and inspection.

1.3 DEFINITIONS

A. Rock Excavation: Natural geological formations or other material which cannot be removed by adequate equipment (in good condition) as defined below, shall be considered a change in the scope of work and paid for by the Owner if encountered.

1. Open Excavation and Grading: Rock in excess of the capabilities of a Caterpillar D-8 tractor (or equivalent) with 2 cu. yd. bucket and hydraulically operated single tooth power ripper.
2. Trenches, Pits and Footings: Rock in excess of the capabilities of a Caterpillar 235 Hydraulic Backhoe (or equivalent) using a 2 ft. Bucket width (3/4 cu. yd.)
3. Minimum Effort: If rock is not removed during the process of normal digging and ripping, then extend the excavation to expose the rock surface within the limit of original excavation. Contact the A/E and he may direct the sides of rock to be exposed to a depth of 3 feet. This will be to determine to the extent of additional work.

B. Earth Excavation: Anything not classified as rock including as example: soils, gravels, stones, boulders, vegetation, debris, and unsuitable materials.

C. Unsuitable Materials: All excavated materials; debris, man made or fabricated materials, concrete spoil, organic, soft, expansive, or unstable matter; all shall be disposed of as herein specified. Excessive moisture content shall not classify a material as unsuitable.

D. Removal and disposal of unsuitable material above the subgrade elevation and placement of approved specific fill material (from on or off the site) above the subgrade elevation as directed by the Soils Engineer shall be considered a part of the work.

E. Removal and disposal of unsuitable material approved below the subgrade elevation and placement of approved specific fill material (from on or off the site) below the subgrade elevation as directed by the Soils Engineer shall be considered a change in the scope of work.

F. Soils Engineer or Inspection Agency: An Agency and its designated representatives who monitor and approve all earthwork operations described herein.

G. Subgrade: The finished elevation of the earth immediately below all slabs, granular and porous fill, paving, footings, walls, etc., except the subgrade elevation shall not be higher than 12" below the existing earth elevation at the start of the project.

H. Subgrade for utility construction: Underside of barrel of pipe, or underside of any cradle or bedding if noted on drawings, or referenced in applicable local government specifications. For pipe drains and miscellaneous structures encased in concrete or on concrete, stone and/or gravel cradle, subgrade is lowest outside surface of encasement or cradle.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

K. Drainage Course: Course supporting the slab on grade that also minimizes upward capillary flow of pore water.

L. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

M. Utilities: On site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

N. Filter Material: Course placed around drainage pipes.

1.4 QUALITY ASSURANCE

A. Reference Standards:

1. American Association of State Highway and Transportation Officials (AASHTO).
2. American Society for Testing and Materials (ASTM).
3. Delaware Department of Transportation, State Highway Administration “Standard Specifications for Materials and Construction”, as amended to date (DelDOT as hereinafter referred). Delete references to Measurement and Payment.

B. Geotechnical Testing Agency Qualifications: An independent testing agency (with a Geotechnical engineer licensed in the state where the project is being constructed on staff)

qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

C. Tolerances: As indicated herein.

D. Testing: Requirements as specified herein.

1.5 SUBMITTALS

A. Notification:

1. Notify and provide data to regulatory authorities and A/E prior to commencement of work.
2. Provide notice of: encounter with unknown utilities; subgrades before filling; areas requiring
3. Testing or inspection.

B. Product Data: For the following:

1. Geotextile.
2. Detection Warning Tape.

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D2487 of each on site and borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D1557 for each on site and borrow soil material proposed for fill and backfill.
3. Field reports; in-place soil density tests.
4. One optimum moisture – maximum density curve for each type of soil encountered.
5. Report of actual unconfined compressive strength and/or results of bearing tests of each strata tested.
6. Test reports must be submitted daily to the Architect and Owner.

1.6 PROJECT CONDITIONS

A. Subsurface Conditions: Subsurface soils investigations have been made at the site. The report and logs of the test borings and test pits are included in the Appendix of these specifications. Such investigations have been made for the purposes of design only and neither the Engineers, the Owner, nor the Geotechnical Engineer guarantee adequacy or accuracy of the data, or that data are representative of all conditions to be encountered. Such information is made available for general information only and shall not relieve the Contractor of the responsibility for making his own investigations, tests, and analysis. Any additional test borings and other exploratory operations may be made by Contractor shall be at no cost to Owner.

1. See Geotechnical Engineering Report prepared by John Hynes & Associates, Inc. in Division 1 for test boring data and other requirements.

B. Erosion and sediment control, in addition to erosion control specified in Section 31100 and Division 1:

1. Standards: Comply with the requirements of the "Standards and Specifications for Soil Erosion and Sediment Control in Developing Areas" by the U.S.D.A. Soil Conservation Service.
2. General Erosion: Prevent erosion of earthwork; repair and correct any ditches, gullies or erosion immediately and upon occurrence.
3. Excavations: Prevent water from flowing into open excavations and toward building walls.
4. Slopes: Cover (with continuous plastic membrane) and stake all slopes steeper than 1.5 horizontal to 1 vertical.

C. Environmental Conditions:

1. Do not apply soil treatment when temperature is at or below freezing or when ground is frozen or frost is expected.
2. Do not apply soil treatment when surface water is present.

D. Existing Conditions: Accept the site in the condition which it exists at the time of the award of the contract and perform all work to the grades indicated.

1. Protect plant material, lawns and other features not designated for removal.
2. Protect bench marks, existing structures, fences, sidewalks, paving and curbs from excavating equipment and vehicular traffic.

E. Existing Utilities: Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.

1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility Owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility Owner.
2. Do not interrupt existing utilities serving facilities occupied and used by others, except when permitted in writing by A/E and then only after acceptable temporary utility services have been provided. Provide a minimum of 48 hour notices to utility Owners and receive written notice to proceed before interrupting any utility.

F. Rock Excavation: Rock excavation may be performed with hoe rams, jack hammers, or any method the Contractor wishes to employ except for explosives.

1.7 PROTECTION

A. Safety: Provide protective measures necessary for the safety of workmen, to the public and adjacent property. Prevent cave-ins, collapse of walls, structures and slopes, both on and adjacent to the site.

B. Standards: Comply with regulations of local authorities having jurisdiction, including all applicable O.S.H.A. requirements.

C. Repair: Includes the removal and replacement with new materials all materials so affected by settlement.

PART 2 - PRODUCTS

2.1 FILL AND BACKFILL

A. Satisfactory Soils:

1. Compacted fill and backfill shall be free of deleterious matter such as frozen materials, organics, wood, debris, or rock larger than 4 inches in diameter and be classified SP, SW, SM, SC, GP, GC, GM, or GW per ASTM D-2487. All material shall have a liquid limit and plasticity index not exceeding 40 and 20 respectively when tested in accordance with ASTM D-4318.
2. The minimum dry unit weight shall not be less than 105 PCF maximum dry density as determined by ASTM D-1557, modified proctor.
3. All fill and backfill materials shall be obtained from on site or from off site sources and shall be approved by the Geotechnical Engineer prior to placement.
4. Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with a least 90 percent passing a 1 ½ inch sieve and not more than 12 percent passing a No. 200 sieve.

1. Locations: All on site fill areas

C. Structural Fill: On-site soils free of organic material, topsoil, miscellaneous fill, debris and rock fragments in excess of 3 inches in their largest dimension may be suitable as structural fill.The granular on-site soils may be suitable for re-use as structural fill. Some of these soils have an in-situ moisture content that exceeds the typical range that would allow the recommended compaction to be achieved. Therefore, drying of these soils may be required to achieve the recommended compaction.

If sufficient quantities of suitable on-site soils are not available for structural fill, imported borrow consisting of predominately granular soils conforming to the requirements of the Delaware Department of Transportation Standard Specifications Select Borrow, Type G should be utilized or AASHTO SP-57 stone.

D. Drainage fill:

1. Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel, (ASTM D 448 Coarse - aggregate grading size 57), with 100% passing of 1-1/2" sieve and not more than 5% passing a No. 8 sieve. Aggregate shall meet DELDOT specification for No. 106A aggregate. Provide by Contractor from off site source.

a. Locations: All concrete slab on grade areas

2. For foundation drainage, use aggregate meeting DELDOT specification for No. 113 ag-

gregate.

a. Locations: Drainage fill behind basement walls and retaining walls.

E. Stone Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, reclaimed concrete, and natural or crushed sand (ASTM D2490) with at least 95% passing a 1 ½" sieve and not more than 8% passing a No. 200 sieve. Provide by contractor from off site sources.

F. Subbase Material: Designation CR-6 in accordance with DELDOT Specifications.

1. Locations: All vehicular traffic areas

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100 percent passing a 1 inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve. For utility installations, bedding shall conform to AASHTO #57 stone.

H. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; AASHTO M-43, size No. 17.

I. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.

J. Processed Rubble Fill: Existing brick and concrete rubble, free of wood and steel may be processed by use of tracked equipment such that no particle size greater than 6 inches in the longest dimension remains.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 FILL AND BACKFILL FOR UTILITIES

A. Backfill: Earth removed from the trench provided that in the opinion of Soils Engineer such excavated material is satisfactory for backfilling.

B. Should the excavated material be considered unsatisfactory for backfilling, the Contractor shall remove and dispose of such unsatisfactory material and substitute, in lieu thereof, suitable material obtained from elsewhere on or off the site.

C. Materials shall meet the requirements specified in paragraph 2.1.A above.

2.3 TOPSOIL

A. Refer to Section 329200 Turf and Grasses.

2.4 SOIL TREATMENT - TERMITE CONTROL

A. Emulsion soil chemicals of only water-based type. Do not use any fuel oil as a diluent.

B. Solutions and chemicals listed and approved by EPA, USDA, and Delaware State Department of Agriculture.

C. Chemicals used in retreatment shall also be certified and state type of chemical and rate of concentration.

2.5 ACCESSORIES

A. Detectable Warning Tape: Acid and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

1. Red: Electric
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems
5. Green: Sewer systems.

2.6 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 157 lbf; ASTM D 4632.
3. Sewn Seam Strength: 142 lbf; ASTM D 4632.
4. Tear Strength: 56 lbf; ASTM D 4533.
5. Puncture Strength: 56 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 70 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.5 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 247 lbf; ASTM D 4632.
3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
4. Tear Strength: 90 lbf; ASTM D 4533.
5. Puncture Strength: 90 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 40 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.7 FLOWABLE FILL

A. Stabilized flowable fly ash mixture with a maximum slump of 8" and a minimum unconfined

compressive strength of 100 psi used to fill construction excavations.

B. Manufacturer: American Stone Mix or approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify existing ground surfaces have been stripped of topsoil, root mat and existing pavement, unsatisfactory soils, concrete spoil, obstructions and deleterious material.

B. Following rough grading and prior to foundation excavation, placement of fill, or construction of the floor slabs, it is recommended that the exposed subgrade be proofrolled. The proofroll should be performed using a minimum 10-ton vibratory roller in the presence of the qualified soils technician working under the supervision of a geotechnical engineer. Yielding or otherwise unsuitable subgrade conditions encountered within the proposed building areas should be undercut to firm subgrade conditions and backfilled with compacted structural fill.

C. Locate underground utilities in areas of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations. Contact "Miss Utility".

D. Use of explosives will not be permitted, unless approved by Owner in writing and Regulatory Agencies having jurisdiction.

E. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

F. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

G. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

H. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.2 EXCAVATION

A. Excavation consists of removal and disposal of material encountered when establishing required finish grade elevations.

B. Unauthorized Excavations:

1. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of A/E. Unauthorized excavation, as well as remedial work directed by A/E, shall be at Contractor's expense.
2. Under footings, foundations, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing to excavation bottom, without altering required top

elevation. Lean concrete, flo-ash fill, or compacted structural fill may be used to bring elevations to proper position, when acceptable by A/E.

C. Additional Excavation: When excavation has reached required subgrade elevations, notify Soils Engineer who will make an inspection of conditions.

1. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated materials as directed by A/E
2. Removal of unsuitable material below the subgrade elevation and its replacement as directed will be paid by the Owner on basis of contract conditions relative to change in work.

D. Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of materials excavated.

1. Maintain sides and slopes of excavations in safe conditions until completion of backfilling.

E. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition.

1. Establish requirements for trench shoring and bracing to comply with local, State & Federal codes and authorities having jurisdiction.
2. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.

F. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.

1. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Excavations shall be kept free of water for a minimum of two (2) inches below subgrade of excavation. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
2. Convey water removed from excavations and rain water into approved sediment control devices. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for each structure. Do not use trench excavations as temporary drainage ditches.
3. Excessive groundwater conditions: Refer to Article 4.3.6 of the General Conditions.

G. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.

1. Prevent saturation of soil above the optimum moisture content.
2. Locate and retain soil materials away from edge of excavations.
3. Dispose of excess soil material and waste materials as herein specified.

H. Excavation for Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10', and extending sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

1. In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. If in excavating for building foundations the soil directly below the building foundations is disturbed, the disturbed soil shall be removed and shall be recompacted to 95% compaction or replaced with concrete backfill.

I. Excavation for Stone and Concrete Pavements: Cut surface under pavements to comply with cross sections, elevations and grades as shown:

1. Where rock or concrete spoil is encountered, carry excavation 18" below subgrade and backfill with suitable material approved by the A/E.

J. Excavation for Trenches: Dig trenches to the uniform width required for particular item to be installed with ample working room.

1. Excavate trenches to depth, lines, gradients, and elevations indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations. Beyond building perimeter, keep bottoms of trenches sufficiently below finish grade to avoid freeze ups.
2. Where rock is encountered, carry excavation 6" below required elevation and backfill with a 6" layer of crushed stone or gravel prior to installation of pipe.
3. Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for entire body of pipe.

    a. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
    b. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.

4. Backfill trenches with concrete where trench excavations pass within 18" of column or wall footings and which are carried below bottom of such footings, or which pass under wall footings. Place concrete to level of bottom of adjacent footing. Concrete is specified in Division 3.
5. Do not backfill trenches until tests and inspections have been made and backfilling authorized by A/E. Use care in backfilling to avoid damage or displacement of pipe systems.

K. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F. (1 degree C.).

L. Ground Surface Preparation (Structural and Pavement areas):

1. The existing ground surface in the structural and pavement areas shall be stripped of topsoil, root mat, existing pavements, unsatisfactory soils, concrete spoil, obstructions and deleterious material. Base course material from the existing pavements may remain if approved by the A/E. The entire area shall be proof rolled, a minimum of four (4) passes, with a loaded dump truck with a minimum axle load of 10 tons in the presence of the soils engineer. Soft spots identified by the Soils Engineer during proofrolling will be undercut and backfilled in accordance with Section 3.4. Proofrolling and compaction equipment shall meet the requirements of Section 3.3.D. Undercutting and backfilling operations for eliminating soft spots above the subgrade elevation shall be included in the base bid.
2. In cut areas, prior to the construction of paving or concrete slab on grade, the entire subgrade shall be proofrolled in the presence of the Soils Engineer. Soft areas encountered during proofrolling shall be undercut and backfilled in accordance with section 3.4. Proofrolling and compaction equipment shall be in compliance with Section 3.3 D. The cost of undercutting and backfilling above the subgrade elevation shall be included in the base bid.

M. Earthwork Quantities:

1. Contractor shall be responsible for determining earthwork quantities for the completion of the work.

3.3 COMPACTION

A. General: Control soil compaction during construction providing percentage of dry density specified for each area classification.

B. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of the maximum dry density which is determined in accordance with ASTM D 1557, or in accordance with ASTM D 2049 for soils which will not exhibit a well defined moisture density relationship.

1. Structural, pavement and walkway areas, steps and utility trenches - 95% of the maximum dry density.
2. Lawn areas outside the designated structural fill limits – minimum compaction 90% of the maximum dry density.

C. Moisture Control: Obtaining a uniformly high degree of compaction requires control over the moisture content of the material being placed in the fills and backfill. The soils used in fill and backfill shall be brought to within 3% of optimum moisture at no additional cost to the Owner.

1. Where the soil layer is too dry, the Contractor shall apply water uniformly using approved equipment to increase the moisture content to within 3% of the optimum, taking precautions to prevent free water from appearing on the surface during or subsequent to compaction operations.
2. Where the soil layer is too wet, the Contractor shall dry the soils by plowing or discing to aerate the soil and reduce the moisture content to within 3% of the optimum.

D. Compaction equipment shall be as required to complete the scope of work outlined in the geotechnical report, contract documents and specifications for this project.

3.4 BACKFILL AND FILL

A. General: Place acceptable soil material in layers not more than eight (8) inches in thickness to required subgrade elevations, for each area classification listed below. Each layer shall be compacted to the requirements of Section 3.3B.

1. Fill and backfill within building and pavement limits and in utility trenches shall be structural fill soils meeting the requirements of Section 2.1.A.
2. Under lawn areas outside the designated structural fill limits, backfill and fill soils shall be soils meeting the requirements of Section 2.1.A, or other on site materials approved by the Geotechnical Engineer.
3. Fill and backfill located below walkways and steps shall be constructed of structural fill soils meeting the requirements of Section 2.1.A.
4. Drainage fill material shall be proof rolled to a uniform stable condition prior to placement of vapor retarder.
5. Stone base course shall be compacted to 95% maximum dry density per ASTM D-1557.

B. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Acceptance of construction below finish grade including, where applicable, subdrainage damp proofing, waterproofing, and perimeter insulation.
2. Concrete and masonry have cured 28 days and is adequately braced.
3. Inspection, testing, approval, and recording locations of underground utilities.
4. Removal of concrete formwork.
5. Removal of trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

C. Ground surface preparation: Shall be in accordance with Section 3.2K.

1. When existing ground surface has density less than that specified under Section 3.3B for particular area classification, break up ground surface, pulverize, moisture condition to optimum moisture content, and compact to required depth and percentage of maximum dry density.

D. Placement and Compaction: Place backfill and fill materials in layers not more than 8" in loose depth, for material compacted by heavy compaction equipment and not more than 4" in loose depth for material compacted by hand operated tampers.

1. Before compaction, moisten or aerate each layer as may be necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density for each classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
2. Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying material uniformly around structure to approximately same elevation in each lift.
3. Structural fill shall extend a minimum of five (5) feet beyond building and road pavement limits and shall include the support slopes to their full width.

4. Backfilling against pipe structures, whose joints involve the use of cement mortar or other concrete, or where buttresses are constructed, shall not be done until mortar has set at least 12 hours.
5. Compaction over one foot above the pipe shall be done with approved mechanical tampers. Compaction density shall be as specified in Section 3.3.

E. Utility trench backfill

1. Place and compact initial backfill of subbase material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
2. Coordinate backfilling with utilities testing.
3. Provide 4-inch thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.
4. Fill voids with approved backfill materials while shoring, bracing, and sheeting is removed.
5. Place and compact final backfill of satisfactory soil material to final subgrade.
6. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.5 ROUGH GRADING

A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surfaces with specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades. In fill areas, sloped surfaces steeper than 5 horizontal to 1 vertical shall be benched so that fill materials will be placed on a level surface. All fill subgrades shall be observed by the Geotechnical Engineer.

B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes, and as follows:

1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 2”' above or below required subgrade elevations.
2. Walks: Shape surface or areas under walks to line, grade and cross section, with finish surface not more than .04' above or below required subgrade elevation.
3. Pavements: Shape surface areas under pavement to line, grade and cross section, with finish surface not more than .04' for bituminous surfaces and 08' for stone surfaces, above or below required subgrade elevation.

C. Grading Surface or Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of .02' when tested with a 10' straightedge.

3.6 BUILDING SLAB BASE COURSE

A. General: Slab base course consists of placement of drainage fill or stone base course material, in layers of indicated thickness, over subgrade surface to support concrete building slabs.

B. Placing: Place slab base course on prepared subgrade in layers of uniform thickness, conforming to indicate cross section and thickness. Maintain optimum moisture content for compacting material during placement operations.

1. When a compacted drainage course is shown to be 6" thick or less, place material in a single layer. Where shown to be more than 6" thick, place material in equal layers, except no single layers more than 6" or less than 3" in thickness when compacted.

C. Any ruts or soft yielding spots which may occur or any areas having inadequate compaction or deviations from the requirements set forth herein shall be corrected by removing and adding uniformly graded crushed stone or by loosening crushed gravel, reshaping and recompacting. The subgrade shall have a uniform density throughout its entire depth and width and shall be approved by the A/E prior to pouring any concrete.

D. Following this preparation, the subgrade shall be protected from damage as described below:

1. The subgrade shall be protected from damage by heavy loads or equipment moving on tracks or cleats.
2. The contractor shall at all times keep the subgrade drained.
3. No concrete shall be deposited upon a frozen subgrade nor, until the subgrade has been approved by the A/E.
4. Immediately in advance of placing concrete, the subgrade shall be sprinklered with as much water as it can readily absorb.

3.7 FINISH GRADING & PLACING TOPSOIL

A. Refer to Specification Section 329200 – “Turf and Grasses”

3.8 MAINTENANCE

A. Protection of graded areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Repair and re establish grades in settled, eroded and rutted areas to specified tolerances.

B. Reconditioning compacted areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

C. Restore areas previously occupied by stockpiled materials to match finished condition of the remainder of the work.

3.9 APPLICATION OF SOIL TREATMENT

A. Refer to Section 313116 Termite control

3.10 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Removal from Owner's Property: Remove waste materials including trash, debris, and unsuitable and excess excavated material, and dispose of off Owner's property.

3.11 FIELD QUALITY CONTROL – SOILS

A. Quality Control Testing During Construction: Allow testing service to inspect and approve subgrades and fill layers before further construction work is performed.

1. Perform field density tests in accordance with ASTM D 1556 (sand cone method) or ASTM D 2922 and D-3017(shallow depth nuclear method), as applicable.
2. Paved Areas and Building Slab Subgrade: Make at least one field density test of subgrade for every 2,000 sq. ft. of paved area or building slab area, but in no case less than 3 tests. In each compacted fill layer, make one field density test for every 2,000 sq. ft. of overlaying building slab or paved area, but in no case less than 2 tests. Field density tests shall be made at all walkway entrances and ramps into the proposed building.
3. Foundation Wall Backfill: Take enough field density tests to ensure backfill is being properly compacted.
4. Utility Trench Backfill: Perform field density tests on a spot-check basis to assist the Contractor in determining if compaction is in accordance with the specifications.
5. If in opinion of A/E, based on testing service reports and inspection, subgrade or fills which have been placed are below specified density, provide additional compaction and testing at no additional expense.
6. Footing Subgrade: For each strata of soil on which footings will be placed, conduct at least one test to verify required design bearing capacities. Subsequent evaluation and approval of each footing subgrade should be performed by Geotechnical Testing Agency.
7. Costs of testing and inspection shall be borne by the Contractor.

3.12 FIELD QUALITY CONTROL - SOIL TREATMENTS

A. Pay costs for required testing of termite control materials. Samples shall be taken and analyzed by an independent testing laboratory.

B. Sampling: Test one sample of working solution for each 10,000 square feet of area applied. Take samples from discharge end of spraying equipment for each batch mixed and applied if less than 10,000 square feet.

C. Retreating: Retreat all areas if the test results average less than 90 percent of listed minimum concentration.

3.13 TESTING AND INSPECTION

A. INSPECTION AGENCY: Construction Manager will employ an Independent Testing agency for purposes of inspecting and testing construction of embankments, fills, backfills, trenches, and subgrades and report to the A/E conformance in all particulars to specification requirements.

B. Scheduling:

1. Assign qualified personnel to be on site at all times when operations are scheduled.

2. The Contractor should note that no earthwork operation shall be permitted in their absence.

C. Responsibilities:

1. Evaluation of subgrade preparation and suitability.
2. Moisture content and field density tests on all layers of fill and backfill material placed.
3. Evaluation of degree of compaction attained for all fill and backfill material placed.
4. Testing and evaluation of borrow material.
5. Sources of borrow and of select fill.
6. Footing subgrade suitability.
7. Inspection of installation of Subdrainage system.

D. Results of Tests:

1. Make results available to the Soils Engineer and A/E immediately upon completion of areas of layers.

E. Final Report: The Inspection Agency shall prepare a written report that summarizes the work inspected during the course of the project. A discussion of all deviations from the contract documents and specifications, with their related impact on the final construction, shall be described in detail. The engineer of record shall review this final report, and recommend corrective measures (as deemed necessary) that must be made prior to final acceptance of the work. Prior to final payment, a written report certifying that the work meets the requirements of the contract documents, specifications, and all governing agencies shall be prepared, submitted, and approved by the A/E.

END OF SECTION 312000

SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes construction dewatering.

B. Related Sections include the following:

1. Division 31 Section "Earth Moving" for excavating, backfilling, site grading and for site utilities.
2. Division 31 Section "Excavation Support and Protection."

1.3 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control ground-water flow into excavations and permit construction to proceed on dry, stable subgrades.

1. Maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
2. Prevent surface water from entering excavations by grading, dikes, well pointing or other means.
3. Accomplish dewatering without damaging existing buildings adjacent to excavation.
4. Remove dewatering system if no longer needed.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with water disposal requirements of authorities having jurisdiction.

B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated.

B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.

1. Make additional test borings and conduct other exploratory operations necessary for dewatering.
2. The geotechnical report is included elsewhere in the Project Manual.

C. Survey adjacent structures and improvements, employing a qualified professional engineer or land surveyor, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

3.2 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed, or until dewatering is no longer required.

C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.

1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.

D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.

1. Maintain piezometric water level below surface of excavation.

E. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

F. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.

1. Remove dewatering system from Project site on completion of dewatering.

G. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

3.3 OBSERVATION WELLS

A. Provide, take measurements, and maintain at least the minimum number of observation wells or piezometers indicated and additional observation wells as may be required by authorities having jurisdiction.

B. Observe and record daily elevation of ground water and piezometric water levels in observation wells.

C. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. Suspend construction activities in areas where observation wells are not functioning properly until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.

1. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

END OF SECTION 312319

SECTION 313116 - TERMITE CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Soil treatment with termiticide.

B. Related Sections include the following:

1. Division 06 Section "Rough Carpentry" for wood preservative treatment by pressure process.
2. Division 07 Section "Sheet Metal Flashing and Trim" for custom-fabricated metal termite shields.

1.3 PERFORMANCE REQUIREMENTS

A. Service Life of Soil Treatment: Soil treatment by use of a termiticide that is effective for not less than 10 years against infestation of subterranean termites.

1.4 SUBMITTALS

A. Product Data: For termiticide borate and metal mesh barrier system.

1. Include the EPA-Registered Label for termiticide and borate products.

B. Product Certificates: For termite control products, signed by product manufacturer.

C. Qualification Data: For Installer of termite control products.

D. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's record information, including the following:

1. Date and time of application.
2. Moisture content of soil before application.
3. Brand name and manufacturer of termiticide.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes, and rates of application used.
6. Areas of application.
7. Water source for application.

8. Areas of application.

E. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located, and who employs workers trained and approved by bait-station system manufacturer to install manufacturer's products.

B. Regulatory Requirements: Formulate and apply termiticides according to the EPA-Registered Label.

C. Source Limitations: Obtain termite control products from a single manufacturer for each product.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination" to schedule application of termiticide products.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.

1.7 COORDINATION

A. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

B. Apply borate treatment after framing, sheathing, and exterior weather protection is completed but before electrical and mechanical systems are installed.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Five years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. Continuing Service: Beginning at Substantial Completion, provide 12 months' continuing service including monitoring, inspection, and re-treatment for occurrences of termite activity. Provide a standard continuing service agreement. State services, obligations, conditions, and terms for agreement period; and terms for future renewal options.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Termiticides:

a. Aventis Environmental Science USA LP; Termidor.
b. Bayer Corporation; Premise 75.
c. Dow AgroSciences LLC; Dursban TC Equity.
d. FMC Corporation, Agricultural Products Group; Talstar Prevail FT Torpedo.
e. Syngenta; Demon TC.

2.2 SOIL TREATMENT

A. Termiticide: Provide an EPA-registered termiticide complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil, interfaces with earthwork, slab and foundation work, landscaping, and other conditions affecting performance of termite control.

1. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparation before beginning application of termite

control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.3 APPLICATION, GENERAL

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.4 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.

1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
2. Foundations: Adjacent soil including soil along the entire inside perimeter of foundation walls, along both sides of interior partition walls, around plumbing pipes and electric conduit penetrating the slab, and around interior column footers, piers, and chimney bases; also along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
3. Crawlspaces: Soil under and adjacent to foundations as previously indicated. Treat adjacent areas including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
4. Masonry: Treat voids.
5. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.

B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

D. Post warning signs in areas of application.

E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

1. Service Frequency: Inspect monitoring stations no fewer than once every three months.

END OF SECTION 313116

SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes temporary excavation support and protection systems.

B. Related Sections include the following:

1. Division 31 Section "Earth Moving" for excavating and backfilling and for existing utilities.
2. Division 31 Section "Dewatering" for dewatering excavations.

1.3 PERFORMANCE REQUIREMENTS

A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.

1. Contractor is solely responsible for maintenance of excavations and worker safety. Architect, Owner and Construction Manager bear no liability for excavation support and protection systems.
2. Provide professional engineering services needed to assume engineering responsibility where required, including preparation of Shop Drawings and a comprehensive engineering analysis by a qualified professional engineer.
3. Prevent surface water from entering excavations by grading, dikes, or other means.
4. Install excavation support and protection systems without damaging existing buildings, pavements, and other improvements adjacent to excavation.

1.4 SUBMITTALS

A. Shop Drawings for Information: Prepared by or under the supervision of a qualified professional engineer for excavation support and protection systems.

1. Include Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.

B. Qualification Data: For Installer and professional engineer.

C. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems.

1.5 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.

B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.

1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.
2. The geotechnical report is included elsewhere in the Project Manual.

C. Survey adjacent structures and improvements, employing a qualified professional engineer or land surveyor; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

1. Shore, support, and protect utilities encountered.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces is not impeded.

D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.

E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.2 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.

1. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.

END OF SECTION 315000

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Hot-mix asphalt paving.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving overlay.
4. Asphalt surface treatments.
5. Pavement-marking paint.
6. Cold milling of existing hot-mix asphalt pavement.

B. Related Sections include the following:

1. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.

1.3 DEFINITIONS

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

B. DOT: Delaware Department of Transportation.

1.4 SYSTEM DESCRIPTION

A. Provide hot-mix asphalt paving according to materials, workmanship, and other applicable requirements of Specifications for road and Bridge Construction of the Delaware Department of Transportation.

1. Standard Specification: Division 400
2. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

C. Job-Mix Designs: For each job mix proposed for the Work.

D. Qualification Data: For manufacturer.

E. Material Test Reports: For each paving material.

F. Material Certificates: For each paving material, signed by manufacturers.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer.

1. Manufacturer shall be a paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of the state in which Project is located.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated, as documented according to ASTM E 548.

C. Regulatory Requirements: Comply with Delaware Department of Transportation Specifications for Road and Bridge Construction for asphalt paving work. All work within DelDOT Right of Way shall conform to the Delaware Department of Transportation Specifications for Road and Bridge Construction.

D. Asphalt-Paving Publication: Comply with AI MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

1. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
2. Review condition of subgrade and preparatory work.
3. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
4. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp. Adhere to all specifications in Delaware Department of Transportation Specifications for Road and Bridge Construction.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at minimum ambient or surface temperatures specified in the Delaware Department of Transportation Specifications for Road and Bridge Construction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials: All materials used under this section shall conform to the requirements of Delaware Department of Transportation Specifications for Road and Bridge Construction, including, but not limited to: graded aggregate, asphalt cement, and tack coat.

B. Herbicide Treatment: Commercial chemical for weed control, registered by Environmental Protection Agency. Provide granular, liquid or wettable powder form. Obtain written approval from the Maryland Department of the Environment prior to application of the herbicide.

1. Manufacturers: Subject to compliance with requirements, provide products of one of the following:

a. Ciba-Geigy Corp.
b. Dow Chemical, USA
c. E.I. Du Pont de Nemours & Co., Inc.
d. FMC Corp
e. Thompson-Hayward Chemical Co.
f. U.S. Borax and Chemical Corp.
g. Allied Chemical Corp.
h. Ag-Chem Products, Inc.

C. Lane Marking Paint: Paint shall comply with Division 700 of the Delaware Department of Transportation Specifications for Road and Bridge Construction.

1. Color: White
2. Color: Yellow
3. Color: Blue

D. Joint Sealants: Joint Sealants shall comply with Delaware Department of Transportation Specifications for Road and Bridge Construction, Divisions 700 & 800.

2.2 MIXES

A. Hot-Mix Asphalt: Provide Plant Mixed, hot-laid, asphalt-aggregate mixture complying with Delaware Department of Transportation Specifications for Road and Bridge Construction, Division 400 and referred Divisions.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

C. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with if formulated by manufacturer for that purpose.
2. Remove spillages and clean affected surfaces.

D. Proceed with paving only after unsatisfactory conditions have been corrected.

E. Tack Coat: Apply to contact surfaces of previously constructed asphalt or Portland cement concrete and surfaces abutting or projecting into hot-mixed asphalt pavement. Distribute at a rate of 0.05 to 0.15 gal. Per sq. yd. of surface in accordance Section 401 of the Delaware Department of Transportation Specifications for Road and Bridge Construction.

F. Allow to dry until at proper condition to receive paving.

G. Exercise care in applying bituminous materials to avoid smearing of adjoining concrete surfaces. Remove and clean damaged surfaces.

3.2 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Mill to a depth of as specified on plans.
2. Mill to a uniform finished surface free of gouges, grooves, and ridges.
3. Control rate of milling to prevent tearing of existing asphalt course.
4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Transport milled hot-mix asphalt to asphalt recycling facility.
7. Keep milled pavement surface free of loose material and dust.

3.3 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into

adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Pump hot undersealing asphalt under rocking slabs until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Patching: Fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.

E. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.4 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.

1. Clean cracks and joints in existing hot-mix asphalt pavement.
2. All cracks greater than 1/8th inch but less than 1/2 inch shall be cleaned to a depth of 1 inch and sealed with hot bitumastic sealer.
3. All cracks greater than 1/2 inch shall be sealed using a slurry seal containing fine sand aggregate. Fill flush with surface of existing pavement and remove excess.
4. Longitudinal cracks shall be sealed using a pavement repair membrane such as paveprep or equal as noted on the construction plans.

3.5 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at minimum temperature of 225 deg F.
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Immediately correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.6 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course. Joints shall comply with Delaware Department of Transportation Specifications for Road and Bridge Construction, Section 401.12.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.7 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 98 percent of reference laboratory density according to AASHTO T 209, but not less than 96 percent nor greater than 100 percent.
2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.8 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.9 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Contractor shall provide striping on parking and roadway surfaces as indicated on the plans. The following is a list of all required striping:

1. Parking stalls.
2. Cross-hatch/gore areas.
3. Handicap Parking symbols.
4. Stop bars.
5. Directional arrows.
6. Lane lines.
7. Words/numbers.

C. Allow paving to age for 30 days before starting pavement marking.

D. Sweep and clean surface to eliminate loose material and dust.

E. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Broadcast glass spheres uniformly into wet pavement markings at a rate of 6 lb/gal. for all markings with the exception of parking stall lines.

3.10 WHEEL STOPS

A. Securely attach wheel stops into pavement with not less than two galvanized steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Construction Manager will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.

B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.

2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.12 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow excavated materials to accumulate on-site.

END OF SECTION 321216

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:

1. Driveways and roadways.
2. Parking lots.
3. Curbs and gutters.
4. Walkways.
5. Unit paver base.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
2. Division 31 Section "Earth Moving" for subgrade preparation, grading, and subbase course.
3. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants of joints in concrete pavement and at isolation joints of concrete pavement with adjacent construction.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Samples: 10-lbsample of exposed aggregate.

D. Qualification Data: For manufacturer. Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

E. Material Test Reports: General contractor will engage a qualified testing agency for indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

F. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

G. Field quality-control test reports.

H. For plazas and wide walkways, submit control joint spacing plan for review.

I. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.

C. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.

D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 96 inches by 96 inches

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and concrete pavement construction practices. Require representatives, including the following, of each entity directly concerned with concrete pavement, to attend conference:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete producer.
d. Concrete pavement subcontractor.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.

1. Use flexible or curved forms for curves with a radius 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

C. Epoxy-Coated Welded Wire Fabric: ASTM A 884/A 884M, Class A, plain steel.

D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

E. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.

F. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.

G. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.

H. Plain Steel Wire: ASTM A 82, as drawn.

I. Deformed-Steel Wire: ASTM A 496.

J. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, plain.

K. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

L. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain steel bars.

M. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

N. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

O. Epoxy Repair Coating: Liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.

P. Zinc Repair Material: ASTM A 780.

2.4 CONCRETE MATERIALS

A. Materials: All materials including but not limited to reinforcing materials, concrete materials, concrete mix, admixtures, curing materials, traffic paint and other related materials used under this section shall conform to the requirements of the Delaware Department of Transportation Specifications for Road and Bridge Construction. References to a required class of concrete shall correspond to the classes as shown in the State of Delaware Department of Transportation Specifications for Road and Bridge Construction Division 500 and Division 800.

B. Fly ash shall meet the approval of the ASTM C-618 pozzolan Class F and may be used as a partial substitute for cement when approved by the Architect.

C. The concrete mix used in performing this work shall be DelDOT Class “A” or DelDOT Class “B” depending on the compressive strength shown on the details and shall meet the approval of the Architect.

D. The concrete temperature shall not exceed 90°F when delivered to the job-site or at any time prior to placement in the forms.

E. Type I - Portland Cement: Shall be used from October 1 through May 1 and when the air temperature in the shade and away from artificial heat is above 70°F or less, or as directed by the Architect.

A. Type II - Portland Cement: Shall be used from May 1 through October 1 and when the air temperature in the shade and away from artificial heat is above 70°F, or as directed by the Architect.

F. When approved by the Architect, Hi-Early strength concrete may be used. Approval will be on a case by case basis.

G. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:

1. Aggregate Sizes: 1/2 to 3/4 inch nominal.
2. Aggregate Source, Shape, and Color: Submit color samples for review by Architect and owner

H. Water: ASTM C 94/C 94M.

I. Air-Entraining Admixture: ASTM C 260.

J. Chemical Admixtures: Admixtures may only be use with prior approval by the Architect. Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.

3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.5 FIBER REINFORCEMENT

A. Synthetic Fiber: fibrillated polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.

1. Available Products:

a. Fibrillated Fibers:

1) Axim Concrete Technologies; Fibrasol F.
2) FORTA Corporation; Forta.
3) Euclid Chemical Company (The); Fiberstrand F.
4) Grace, W. R. & Co.--Conn.; Grace Fibers.
5) SI Concrete Systems; Fibermesh.

2.6 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

1. Available Products:

a. Axim Concrete Technologies; Cimfilm.
b. Burke by Edeco; BurkeFilm.
c. ChemMasters; Spray-Film.
d. Conspec Marketing & Manufacturing Co., Inc.; Aquafilm.
e. Dayton Superior Corporation; Sure Film.
f. Euclid Chemical Company (The); Eucobar.
g. Kaufman Products, Inc.; Vapor Aid.
h. Lambert Corporation; Lambco Skin.
i. L&M Construction Chemicals, Inc.; E-Con.
j. MBT Protection and Repair, ChemRex Inc.; Confilm.
k. Meadows, W. R., Inc.; Sealtight Evapre.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
n. Sika Corporation, Inc.; SikaFilm.

o. Symons Corporation; Finishing Aid.
p. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.

E. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.

1. Available Products:

a. Anti-Hydro International, Inc.; AH Curing Compound #2 WP WB.
b. Burke by Edoco; Resin Emulsion White.
c. ChemMasters; Safe-Cure 2000.
d. Conspec Marketing & Manufacturing Co., Inc.; W.B. Resin Cure.
e. Dayton Superior Corporation; Day-Chem White Pigmented Cure (J-10-W).
f. Euclid Chemical Company (The); Kurez VOX White Pigmented.
g. Kaufman Products, Inc.; Thinfilm 450.
h. Lambert Corporation; Aqua Kure-White.
i. L&M Construction Chemicals, Inc.; L&M Cure R-2.
j. Meadows, W. R., Inc.; 1200-White.
k. Symons Corporation; Resi-Chem White.
l. Tamms Industries, Inc.; Horncure 200-W.
m. Unitex; Hydro White.
n. Vexcon Chemicals, Inc.; Certi-Vex Enviocure White 100.

2.7 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

D. Chemical Surface Retarder: (For exposed aggregate concrete) Water-soluble, liquid-set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.

1. Products:

a. Burke by Edeco; True Etch Surface Retarder.
b. ChemMasters; Exposee.
c. Conspec Marketing & Manufacturing Co., Inc.; Delay S.
d. Euclid Chemical Company (The); Surface Retarder S.
e. Kaufman Products, Inc.; Expose.
f. Metalcrete Industries; Surftard.
g. Nox-Crete Products Group, Kinsman Corporation; Crete-Nox TA.

h. Scofield, L. M. Company; Lithotex.
i. Sika Corporation, Inc.; Rugasol-S.
j. Vexcon Chemicals, Inc.; Certi-Vex Envioset.

2.8 WHEEL STOPS

A. Wheel Stops: Solid, 3000 PSI concrete, precast.

1. Dowels: Galvanized steel, 3/4-inch diameter, 10-inch minimum length.

2.9 ADA TRUNCATED DOMES

A. General: In-line replacable designed to be installed in a “wet set” condition. Units must include anchors which allow replacement by removing colored covers and bolts while leaving anchors in place.

B. Materials: Homogenous glass and carbon reinforced composite

1. UV stable and colorfast.
2. Resistant to slat and chemical staining per ASTM B 117 & 1308.
3. Minimum Compressive and Tensile Strength of 28,900 psi and 11,600 psi respectively.
4. Must be able to handle load bearing capacity of 16,000 lbs per AASHO –H20 with no visible damage.
5. Color must be uniform throughout with no paint or coating to provide color.
6. Dome geometry must comply with ADA regulations for detectable warnings at curb ramps in diameter, height and spacing.

C. Where installation on radius is shown, provide precut and scored units for installation without gaps and piecemeal infills. Field cut rectangular units will not be acceptable.

D. Units shall be by ADA Solutions, Inc. or approved equal.

2.10 CONCRETE MIXTURES

A. The concrete mix used in performing this work shall be DelDOT Class “A” or DelDOT Class “B” depending on the compressive strength shown on the details and shall meet the approval of the Architect.

B. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.

C. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 4000 psi or 3000 psi. depending on location
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50.
3. Slump Limit: 2-5, plus or minus 1 inch.

D. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: 6 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.

E. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

F. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture, plasticizing and retarding admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

G. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals. Limits shall be as follows per DelDOT requirements:

1. Fly Ash or Pozzolan: 25 percent.
2. Ground Granulated Blast-Furnace Slag: 50 percent.
3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

H. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd..

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116 where synthetic fibers are noted on the plans. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 15 tons.
3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in Division 31 Section "Earth Moving."

C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.

1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
2. Provide tie bars at sides of pavement strips where indicated.
3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 20 feet, unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. All Isolation Joints shall be treated with joint filler.
4. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. For larger walkways, width greater than 12’ and plazas, submit shop drawing of joint pattern. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 3/8-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
2. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 3/8-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

H. Screed pavement surfaces with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.

K. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.

L. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

M. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.

N. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Construct test sections of each type of concrete paving, including at least one expansion joint and control joints, for review by CM, Owner and Architect for agreement of finish prior to starting concrete installation. Review will include texture of broom finish, joint striking, picture framing and geometric conformity.

2. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3. Incorporate “picture framing” of concrete in finish within lump sum prices bid.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.9 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.10 WHEEL STOPS

A. Securely attach wheel stops into pavement with not less than two galvanized steel dowels embedded in holes drilled or cast into wheel stops at one-quarter to one-third points. Firmly bond each dowel to wheel stop and to pavement. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Construction Manager shall engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.

a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.12 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Expansion and contraction joints within cement concrete pavement.

B. Related Sections include the following:

1. Division 07 Section "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.
2. Division 32 Section "Concrete Paving" for constructing joints in concrete pavement.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F .
2. When joint substrates are wet or covered with frost.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

2.3 COLD-APPLIED JOINT SEALANTS

A. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, non-sag silicone sealant complying with ASTM D 5893 for Type NS.

1. Products:

a. Crafco Inc.; RoadSaver Silicone.
b. Dow Corning Corporation; 888.

2.4 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of backer materials.
2. Do not stretch, twist, puncture, or tear backer materials.
3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.

G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 321373

SECTION 329200 – TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section. Execute the work of this Specification in accordance with applicable portions of:

1. Division 1 – General Requirements
2. Drawings L-101, L-102

1.3 SUMMARY

A. Section Includes:

1. Seeding.
2. Hydroseeding.
3. Turf renovation.
4. Erosion-control material(s).

B. Related Sections:

1. Division 31 Section "Site Clearing" for topsoil stripping and stockpiling.
2. Division 31 Section "Earth Moving" for excavation, filling and backfilling, and rough grading.
3. Division 32 Section "Plants" for border edgings.

1.4 DEFINITIONS

A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

B. Finish Grade: Elevation of finished surface of planting soil.

C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

H. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

I. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to this Project.

1.6 INFORMATIONAL SUBMITTALS

A. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass. Include identification of source and name and telephone number of supplier.

B. Qualification Data: For qualified landscape Installer.

C. Product Certificates: For soil amendments and fertilizers, from manufacturer.

D. Material Test Reports: For existing, in-place surface soil and imported topsoil.

E. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required initial maintenance periods.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Three years' experience in turf installation in addition to requirements in Division 01 Section "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

   a. Certified Landscape Technician - Exterior, with specialty area(s), designated CLT-Exterior.
   b. Certified Turfgrass Professional, designated CTP.
   c. Certified Turfgrass Professional of Cool Season Lawns, designated CTP-CSL.

5. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
6. Pesticide Applicator: State licensed, commercial.

B. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.

1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
2. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
3. Report suitability of tested soil for turf growth.

   a. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
   b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

D. Pre-installation Conference: To Be Announced

1.8 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

1.9 PROJECT CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance.

1. Spring Planting: March 15 – June 15
2. Fall Planting: September 15 – November 15

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.10 MAINTENANCE SERVICE

A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:

1. Seeded Turf: 90 days from date of installation.

a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

2. Sodded Turf: (Alternate to Bid) 30 days from date of installation.

B. Initial Meadow Maintenance Service: (NOT USED).

C. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

** END OF PART 1 **

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species: State-certified seed of grass species as follows: (As noted on Plans L-101 and l-102) for Parking Area Bio-retention and embankment of wet pond.

C. Seed Species: (For Fine Lawn Areas) Seed of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

1. Full Sun: Bermudagrass (Cynodon dactylon).
2. Full Sun: Kentucky bluegrass (Poa pratensis), a minimum of three cultivars.
3. Sun and Partial Shade: Proportioned by weight as follows:

    a. 50 percent Kentucky bluegrass (Poa pratensis).
    b. 30 percent chewings red fescue (Festuca rubra variety).
    c. 10 percent perennial ryegrass (Lolium perenne).
    d. 10 percent redtop (Agrostis alba).

4. Shade: Proportioned by weight as follows:

    a. 50 percent chewings red fescue (Festuca rubra variety).
    b. 35 percent rough bluegrass (Poa trivialis).
    c. 15 percent redtop (Agrostis alba).

D. Grass Seed Mix: Proprietary seed mix as follows:

1. Products: Subject to compliance with requirements, As Specified by Ernst Conservation Seeds.

2.2 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 85 percent calcium carbonate , ground so that not less 90% passes a 10 mesh sieve and not less than 30% passes a 100 mesh sieve. Apply at the rate adequate to bring pH range up to 6.0 to 6.5.

B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, and with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: Horticultural perlite, soil amendment grade.

F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.

G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.3 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through ½ inch sieve; soluble salt content of 4 to 8 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: (NOT USED).

B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, with a pH range of 3.4 to 4.8.

C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.

D. Wood Derivatives: (Not Used).

E. Manure: (Not Used).

2.4 FERTILIZERS

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
3. For lawns, provide fertilizer with not less than 4% phosphoric acid and not less than 2% potassium and the percentage of nitrogen required to provide not less than 1 lb. of actual nitrogen per 1000 sq. ft. of lawn area. Provide nitrogen in a form that will be available to the lawn during the initial period of growth.

2.5 PLANTING SOILS

A. TOPSOIL

Topsoil shall be from off-site sources. It shall be without admixture of subsoil or slag and shall be free of stones, lumps, plants or their roots, sticks and extraneous matter, and shall not be moved, placed or used while in a frozen or muddy condition.

Topsoil from off-site sources shall have an acidity range of pH 5.0 to 7.0 and shall contain not less than 5% organic matter as determined by the "Walkley-Black Method" (Colorimetric version). Sufficient limestone shall be added to topsoil used to bring it to a range of pH 6.0 to pH 6.5.

Soil sample tests will be ordered by the Landscape Architect and shall be made by a state or commercial laboratory using methods approved by the Associates of Official Agricultural chemists or the State Agricultural Experiment Station.

Such analysis will be paid for by the Contractor. Moving and placing of topsoil may be made after approval of the analysis by the Landscape Architect.

If approved, natural topsoil not having the hydrogen-ion value specified above may be amended by the contractor, at his own expense, to bring it within the specified limits. Topsoil shall meet the following mechanical analysis:

	Passing %	Retained %
1" Screen	100%	0%
1/2" Screen	97-100%	0-3%
No. 100 Mesh Sieve	60-40%	40-60%

There shall be a minimum of 4" of topsoil (after settlement) in all plant beds, pit plantings, ground cover areas, and lawns or as called for on the drawings whichever is greater.

B. LIGHT WEIGHT ON-STRUCTURE PLANTING SOIL (NOT USED)

2.6 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Sphagnum Peat Mulch: Partially decomposed sphagnum peat moss, finely divided or of granular texture, and with a pH range of 3.4 to 4.8.

C. Muck Peat Mulch: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.

D. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content 2-5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content 50-60 percent of dry weight.
2. Feedstock: (NOT USED).

E. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

F. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

G. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.7 PESTICIDES

A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.8 EROSION-CONTROL MATERIALS

A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples.

B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd. with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples,

C. Erosion-Control Mats: Cellular, non-biodegradable slope-stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface,. Include manufacturer's recommended anchorage system for slope conditions.

** END OF PART 2 **

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. Limit turf subgrade preparation to areas to be planted.

B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 6 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Thoroughly blend planting soil off-site before spreading.

a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
b. Mix lime with dry soil before mixing fertilizer.

2. Spread planting soil to a depth of 6 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

a. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.
b. Reduce elevation of planting soil to allow for soil thickness of sod.

C. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:

1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
2. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.

3. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

E. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

F. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

A. Prepare area as specified in "Turf Area Preparation" Article.

B. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.

C. Fill cells of erosion-control mat with planting soil and compact before planting.

D. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.

E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged.
2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of as noted on plans.

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.

E. Protect seeded areas with erosion-control mats where shown on Drawings; install and anchor according to manufacturer's written instructions.

F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

G. Protect seeded areas from hot, dry weather or drying winds by applying peat mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch, and roll surface smooth.

3.6 HYDROSEEDING

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Mix slurry with [fiber-mulch manufacturer's recommended tackifier.
2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than [1500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.
3. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre.

3.7 TURF RENOVATION

A. Renovate existing turf.

B. Renovate existing turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
2. Install new planting soil as required.

C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.

D. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

E. Mow, dethatch, core aerate, and rake existing turf.

F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches

I. Apply soil amendments and initial fertilizers required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.

J. Apply seed and protect with straw mulch as required for new turf.

K. Water newly planted areas and keep moist until new turf is established.

3.8 TURF MAINTENANCE

A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

D. Turf Post fertilization: Apply fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.9 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over and bare spots not exceeding 5 by 5 inches .
2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
3. Satisfactory Plugged Turf: (NOT USED).
4. Satisfactory Sprigged Turf: (NOT USED).

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.10 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.11 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

C. Remove nondegradable erosion-control measures after grass establishment period.

** END OF PART 3 **

SECTION 329300 – PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary conditions and Division 1 Specification Sections, apply to this Section. Execute the work of this Specification in accordance with applicable portions of:

2. Division 1 - General Requirements
3. Drawings L-101

1.2 SUMMARY

A. Section Includes:

1. Plants
2. Planting soils
3. Tree stabilization

B. Related Sections:

1. Division 01 Section "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work
2. Division 31 Section "Site Clearing" for protection of existing trees and plantings, topsoil stripping and stockpiling, and site clearing.
3. Division 32 Section "Turf and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.

C. Work By Others;

1. Installation of Bituminous Parking Lots and Drives.
2. Installation of Concrete Curbs, Concrete Walks and Wheel Stops.
3. Buildings, Building addition and building renovation and utilities.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of plant required.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

G. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.

H. Finish Grade: Elevation of finished surface of planting soil.

I. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

J. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

K. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

L. Planting Area: Areas to be planted.

M. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

N. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

O. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

P. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

Q. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

R. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

S. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including soils.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
2. Pesticides and Herbicides: Include product label and manufacturer's application instruction specific to the Project.
3. Plant Photographs: Include color photographs in either digital or 3- by 5-inch (76- by 127-mm) print format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 10 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Samples for Verification: For each of the following:

1. Trees and Shrubs: Contact Landscape Architect for review of plant material, based on information received above in product data. The Landscape Architect reserves the right to inspect trees and shrubs either at place of growth or at site before planting, for compliance with requirements for name, variety, size and quality. Provide trees and shrubs grown in a recognized nursery in accordance with good horticultural practice. Provide healthy, vigorous stock grown under climatic conditions similar to conditions in the locality of the project and free of disease, insects, eggs, larvae, and defects such as knots, sunscald, injuries, abrasions or disfigurement. Provide trees and shrubs of the sizes shown as specified. Trees and shrubs of larger size may be used, if acceptable to Landscape Architect, and if sizes of roots or balls are increased proportionately.
2. Mulch: one quart volume of each organic mulch required, in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall by typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
3. River Stone; Submit a minimum of 5 full size samples stone providing the 3 to 4 inch diameter required. Include full range of style, size, finish, color & texture proposed for the work.

4. Filter Fabric: 12 x12” sample, with manufacturer specifications.
5. Precast Concrete Paver; Submit a minimum of 5 full size samples of each color paver unit required. Include the full range of style, size, finish, color and texture proposed for the work.

1.5 INFORMATIONAL SUBMITTALS

A. Qualifications: The Landscape Work shall be done by a single firm specializing in landscaping work. Include list of similar projects completed, demonstration Installer’s capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners’ contact persons.

B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. General: Ship landscape materials with certificates of inspection as required by governmental authorities. Comply with governing regulation applicable to landscape materials.
2. Manufacturer’s certified analysis of standard products.
3. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

C. Material Test Reports:

1. Certification: For information only, submit 2 copies of certificates of inspection as required by governmental authorities, and manufacturer's or vendor's certified analysis for soil amendments and fertilizer materials. Submit other data substantiating that materials comply with specified requirements.

D. Maintenance Instructions: Maintenance Instructions: Submit two copies of typewritten instructions recommending procedures to be established by the Owner for the maintenance of landscape work for one full year. Submit prior to expiration of required maintenance period(s).

E. Provide two copies of warranty (See Item 1.11 for specific requirements).

F. Schedule of Work: For information only, submit 3 copies of tentative schedule to Owner and/or Owner's Agent along with Landscape Architect. Contractor shall keep all parties above apprised of any changes so that the Owner's Agent is aware of scheduled work at least 24 hours prior to said work being started.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Provide Professional Memberships.

2. Provide number of years experience in Landscape Installation in addition to requirements in Division 01 Section “Quality Requirements”
3. Provide Field Supervision Installers experience. Note full-time Supervisor to be on Project Site at all times when landscape installation is in progress.
4. Pesticide Applicator: Licensed

B. Provide Soil-Testing Laboratory Name and Qualifications.

C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil testing laboratory stating percentages of organic matter,; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant nutrient content of the soil.

1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Landscape Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
3. Report suitability of tested soil for plant growth.

   a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq ft or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
   b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

D. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1. Do not make substitutions: If specified landscape material is not obtainable, submit to Landscape Architect proof of non-availability and proposal for use of equivalent material. When authorized, adjustment of Contract amount will be made.

E. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Landscape Architect of sources of planting materials 14 days in advance of delivery to site.

F. Hardscape Materials: Materials and methods of construction shall comply with American Society for Testing and Materials (ASTM). Installation shall be performed by skilled workmen with a

satisfactory record of performance on completed projects of comparable size and quality. Do not change source of Hardscape Materials during the course of the work.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable. Protect materials from deterioration during delivery, and while stored at the site.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers, and soil amendments with appropriate certificates.

C. Plant Materials:

1. Bare- Root Stock: Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
2. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
3. Label at least one tree and one shrub of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name.
4. Do not remove container grown stock from containers until planting time.
5. Handle planting stock by root ball.
6. Bulbs: NOT USED
7. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six(6) hours after delivery, set plants and trees in their appropriate conditions, protect from weather and mechanical damage, and keep roots moist.

    a. Set balled stock on ground and cover ball with soil, peat moss, or other acceptable material.
    b. Do not remove container-grown stock from containers before time of planting.
    c. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.
    d. Heel-in bare-root stock. Soak roots that are in dry condition in water for two hours. Reject dried-out plants.

D. Precast Concrete Unit Pavers.

1. Protect units from damage, chipping, and soiling during delivery and storage. Store off the ground on pallets or wood platforms in an area designated by the Owner.
2. Store pavers and curb units ordered as overage, for Owner's future use, on site, as directed by the Owner's Agent.
3. Cold weather:

   a. Do not use frozen materials or materials mixed or coated with ice or frost.
   b. Do not build on frozen work or wet, saturated or muddy subgrade. Remove and replace paving damaged by frost or freezing.
4. Protect partially completed paving against weather damage when work is not in progress.
5. Provide temporary barricades and warning lights as required for protection of project work and public safety.
6. Protect adjacent work from damage, soiling, or staining during paving operation.

1.8 PROJECT CONDITIONS

A. Field Measurements: Installer must verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work. Installer must observe the conditions under which work is to be performed, and notify the Landscape Architect of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:

1. Notify the Landscape Architect/ Construction Manager and or Owner no fewer seven days in advance of proposed interruption of each service or utility.
2. Do not proceed with interruption of services or utilities without Construction Managers and or Owner's written permission.

C. Planting Restrictions: Proceed with and complete the landscape work as rapidly as portions of the site become available, working within the seasonal limitations for each kind of landscape work required. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

D. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Landscape Architect before planting.

E. Planting Schedule: Prepare a proposed planting schedule. Schedule the dates for each type of landscape work during normal seasons for such work in the area of the site. Correlate with specified maintenance periods to provide maintenance until acceptance by the Owner. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.

F. Coordination with Lawns: Plant trees and shrubs after final grades are established and prior to planting of lawns, unless otherwise acceptable to the Landscape Architect. If planting of trees and shrubs occurs after lawn work, protect lawn areas and promptly repair damage to lawns resulting from planting operations.

G. Protect existing trees, shrubs and other hardscape elements against damage including trespassing, and erosion.

H. Protect all existing plant material in the area of this contract, whether inside or outside the contract limit line, against any damage, which in the opinion of the Landscape Architect will cause death or major retardation. Such material shall be replaced with same size and species by the Contractor at no additional cost should such damage occur.

I. Inspection of work will be made at the conclusion of work (at acceptance of the project). Submit written notice requesting final inspection at least 10 days prior to anticipated date.

1.9 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to the following:

   a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond contractor's control.
   b. Structural failures including plantings, falling or blowing over.
   c. Structural failures of tree stabilization structures, or stone energy dissipaters

2. Warranty periods will begin from the Date of installation completion (as determined by the Landscape Architect for a period of 12 months (one year).

3. Include the following remedial actions as a minimum.

   a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
   b. Replace plants that are move than 25 percent dead or in an unhealthy condition at end of warranty period.
   c. A limit of one replacement for each plant will be required except for losses or replacements due to failure to comply with requirements.
   d. Provide extended warranty for a period equal to the original warranty period, for replaced plant material.

4. Hardscape: Guarantee Paver Entrances and Walks for a period of one year after date of acceptance against defects; including chipping, cracks, discoloration and settlement; except for defects resulting from neglect by owner, abuse or damage by others or unusual phenomena or incidents which are beyond landscape

installers control. Final decisions regarding replacement shall be made by the Landscape Architect.

1.10 MAINTENANCE

A. Maintain lawns for not less than the period stated below, and longer as required to establish an acceptable lawn.

1. Seeded and/or sodded lawns, not less than 60 days. If seeded in Fall and not given full 60 days of maintenance, or if not considered acceptable at that time, continue maintenance the following Spring until acceptable lawn is established.

B. Maintain lawns by watering, fertilizing, weeding, mowing, trimming and other operations such as rolling, regrading, and replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas.

C. All planted trees, shrubs, groundcovers and annual flowers, shall be maintained until final acceptance of the completed contract. This shall be not less than 60 days. Maintenance shall include watering, cultivating, control of insects, fungus, and other horticultural operations necessary for the proper growth of all plants.

** END OF PART I **

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings L-102, L-103, L-104 and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders (unless otherwise indicated); tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; or with stem girdling roots will be rejected.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 "Standard for Nursery Stock" for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls. Provide plant materials true to name and variety established by the American Joint Committee on Horticultural Nomenclature "Standardized Plant Names," Second Edition, 1942.

C. Deciduous Trees: Provide trees of height and caliper listed or shown and with branching configuration recommended by ANSI Z60.1 for type and species required. Provide single stem trees except where special forms are shown or listed.

1. Provide balled and burlapped (B&B) deciduous trees.
2. Container grown deciduous trees will be acceptable in lieu of balled and burlapped deciduous trees subject to specified limitations of ANSI Z60.1 for container stock.

D. Deciduous Shrubs: Provide shrubs of the height shown or listed and with not less than the minimum number of canes required by ANSI 260.1 for the type and height of shrub required.

1. Provide balled and burlapped (B&B), bare root (B.R.) or container deciduous shrubs as specified in plant list.
2. Container grown deciduous shrubs will be acceptable in lieu of balled and burlapped deciduous shrubs subject to the specified limitations for container grown stock.

E. Coniferous and Broadleaved Evergreens: Provide evergreens of the sizes shown or listed. Dimensions indicate minimum spread for spreading and semi- spreading type evergreens and height for other types, such as globe, dwarf cone, pyramidal, broad upright and columnar. Provide normal quality evergreens with well-balanced from complying with requirements for other size relationships to the primary dimension shown.

1. Provide balled and burlapped (B&B) or container grown evergreens as specified.
2. Container grown evergreens will be acceptable in lieu of balled and burlapped evergreens subject to the specified limitations for container grown stock.

F. Labeling: label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.

G. If formal arrangements or consecutive order of plants is shown on plans, select stock for uniform height and spread, and number the labels to assure symmetry in planting

2.2 INORGANIC SOIL AMENDMENTS

A. Ground Limestone: (To be incorporated into soil if soil pH value test shows low level of soil Ph which needs to be raised). ASTM C 602, natural limestone containing not less than 85% of total carbonates, ground so that not less 90% passes a 10 mesh sieve and not less than 30% passes a 100 mesh sieve. Apply at the rate adequate to bring pH range up to 6.0 to 6.5.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No.6 sieve and a maximum of 10 percent passing through no. 40 sieve.

C. Iron Sulphate: Granulated ferrous sulfate containing a minimum of 20 percent and 10 percent sulfur. (To be incorporated into soil if soil pH value test shows high level of soil pH which needs to be lowered.) Iron Sulphate shall be applied at the rate adequate to bring pH range down to 6.0 to 6.5 and as per "Cornell Recommendations for Commercial Turf Grass Management".

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: Horticultural perlite, soil amendment grade.

F. Agricultural gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.

G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent waterabsorption capacity by weight.

I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.3 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1/2 inch sieve sieve; soluble salt content of 4 to 8 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight

B. Peat Humus: FS Q-P-166 and with the texture and pH range OF 3.4 TO 4.8.

C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.

2.4 FERTILIZERS

A. Bonemeal: Commercial, raw, or steamed, finely ground; 4% nitrogen and 20% phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, Soluble; a minimum of 20% available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium.

1. For All New Trees and Shrubs:

All trees and shrubs shall be fertilized with a controlled release 16-8-16 analysis fertilizer contained in a polyethylene perforated bag with micropore holes. The bag shall contain four (4) ounces minimum of water soluble fertilizer so as to be effective for eight (8) years.

The packets shall be placed equidistantly within the planting pit adjacent to the ball or root mass, but not in direct contact with roots. Placement depth shall be 6 to 8 inches. Packets shall not be cut, ripped or damaged. If it becomes necessary to remove and replace dead or unhealthy plants, damaged or broken packets shall be replaced with new packets.

A "Certificate of Compliance" must accompany invoice showing quantity of material ordered, where material was supplied and shipped to, and its consigned route and specific job application.

2. For lawns, provide fertilizer with not less than 4% phosphoric acid and not less than 2% potassium and the percentage of nitrogen required to provide not less than 1 lb. of actual nitrogen per 1000 sq. ft. of lawn area. Provide nitrogen in a form that will be available to the lawn during the initial period of growth.

D. Organic Fertilizer and Soil Conditioner: All trees and shrubs shall be treated with PHC Healthy Start which contains a blend of natural organic nutrients, proteins, sugars and other carbohydrates, humic acids, biostimulants and beneficial bacteria that enrich soil.

PHC Healthy Start is available from Plant Health Care, Inc., 440 William Pitt Way, Pittsburgh, Pennsylvania, 1-800-421-9051.

E. Superabsorbent Co-polymer for trees, shrubs, herbaceous ground cover and coniferous ground cover shall be "Terra-Sorb" AG as manufactured by Industrial Services International, Inc., PO Box 10834, Bradenton, Florida, 34282-0834, Telephone (800) 227-6728.

F. Terra-Wet: All trees, shrubs, and coniferous ground cover shall be treated with Terra-Wet which is a performance enhanced wetter/penetrant derived from Yucca Schidigera plants.

Terra-Wet is available from Plant Health Care, Inc., 440 William Pitt Way, Pittsburgh, Pennsylvania, 1800-421-9051.

G. Natural Organic Biostimulant for herbaceous and coniferous ground cover shall be “Dry Roots 2” root growth enhancer and soil conditioner as manufactured by Roots Inc. a division of LISA Products Corp., 25 Science Park , New Haven, CT 06511 (203) 786-5295.

H. Doggett 32-7-7 Slow Release Tree Fertilizer: All existing trees over 8” caliper to remain on main site with Doggett 32-7-7 Slow Release Tree Fertilizer as manufactured by The Doggett Corporation, Lebanon, NJ 08833, 1-800-448-1862.

I. Doggett’s Natural Resource: All existing trees over 8” caliper to remain on the main site shall be injected with Doggett’s Natural Resource as manufactured by The Doggett Corporation, Lebanon, NJ 08833, 1-800-448-1862.

J. Mycor Tree, Tree Saver Pt Injectable: All existing trees over 8” caliper to remain on the main site shall be injected with Mycor Tree, Tree Saver Pt Injectable, which is an ectomycorrihizal fungi superstrain inoculant containing live spores of beneficial ectomycorrhizal fungi, a polyacrylamide superabsorbent and plant biostimulants to ensure the survival and performance of newly planted trees and shrubs. Mycor Tree, Tree Saver Pt Injectable is available from Plant Health Care, Inc., 44 William Pitt Way , Pittsburgh, Pennsylvania, 1-800-421-9051.

2.5 PLANTING SOILS

A. TOPSOIL

Topsoil shall be from off-site sources. It shall be without admixture of subsoil or slag and shall be free of stones, lumps, plants or their roots, sticks and extraneous matter, and shall not be moved, placed or used while in a frozen or muddy condition.

Topsoil from off-site sources shall have an acidity range of pH 5.0 to 7.0 and shall contain not less than 5% organic matter as determined by the "Walkley-Black Method" (Colorimetric version). Sufficient limestone shall be added to topsoil used to bring it to a range of pH 6.0 to pH 6.5.

Soil sample tests will be ordered by the Landscape Contractor and shall be made by a state or commercial laboratory using methods approved by the Associates of Official Agricultural chemists or the State Agricultural Experiment Station.

Such analysis will be paid for by the Contractor. Moving and placing of topsoil may be made after approval of the analysis by the Landscape Architect.

If approved, natural topsoil not having the hydrogen-ion value specified above may be amended by the contractor, at his own expense, to bring it within the specified limits. Topsoil shall meet the following mechanical analysis:

	Passing %	Retained %
1" Screen	100%	0%
1/2" Screen	97-100%	0-3%
No. 100 Mesh Sieve	60-40%	40-60%

There shall be a minimum of 4" of topsoil (after settlement) in all plant beds, pit plantings, ground cover areas, and lawns or as called for on the drawings whichever is greater.

2.6 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of the following:

1. Mulch: Shall be 100% Double Hammered Milled Shredded Hardwood Bark Mulch. Mulch shall be free from any extraneous materials, and spread to a 3" depth minimum (after settlement). Contractor shall submit certification detailing content and source of mulch for Landscape Architect's approval.
2. Color: Natural

2.8 PESTICIDES

A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.9 TREE STABILIZATION MATERIALS

A. Stakes and Guys:

1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, treated softwood with specified wood pressure-preservative treatment, free of knots, holes, cross grain, and other defects, (6” by 6” by 3’-6” min), pointed at one end.
2. Wood Deadmen: Timbers measuring 8”in diameter and 48”long, treated with specified wood pressure-preservative treatment.
3. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, two-strand, twisted, 12 gauge.
4. Guy Cables: Five-strand, galvanized-steel cable, with zinc-coated turnbuckles, a minimum of 3 inches long, with two 3/8 inch galvanized eyebolts.

2.10 LANDSCAPE EDGINGS

Sure-Loc Aluminum Edging (or approved equal) 1/8” X 5.5”, standard mill finish. Stakes @ 1.5 X 11.5” extruded aluminum 6063 alloy T6 hardness. Edging to lock with no overlap at joints. Install with 5 stakes per 16’ length. Section stakes are to be extruded aluminum 6061 alloy T6 hardness. Stakes to be installed ½” below top edge out of view. At all start points and stop points, install end stake adaptors. Sure-Loc can be located at 1-800-787-3562.

2.12 MISCELLANEOUS LANDSCAPE MATERIALS

A. Anti-Desiccant: Emulsion type, film-forming agent similar to Dowax by Dow Chemical Co., or Wilt-Pruf by Nursery Specialty Products, Inc., designed to permit transpiration, but retard excessive loss of moisture from plants. Deliver in manufacturer's fully identified containers and mix in accordance with manufacturer's instructions. All plants shall be sprayed with an anti-desiccant once in late Fall (November) and once in late Winter (February).

B. Wrapping: Tree-wrap tape not less than 4" wide, designed to prevent borer damage and winter freezing.

C. Filter Fabric: Filter weave 40/10 as manufactured by Nicolon/Mirafi Group. Filter weave 40/10 is available from Ragen Associates. 20 Larsen Rd., Iselin, NJ 08830, (732)602-9500 or (800)752-1010 outside NJ.

D. Precast Concrete Unit Pavers: Paver unit materials and fabrication shall meet or exceed the requirements of ASTM C936-82 Standard Specifications for Concrete Paving Stone.

1. Portland cement: ASTM C150, Type 1
2. Aggregate: ASTM C33
3. Compressive strength: Minimum 8,000 psi at time of delivery.
4. Absorption: Maximum 5%
5. Freeze-thaw test: ASTM C67, no breakage and maximum 1% loss in dry weight after 50 cycles.
6. Abrasion resistance: ASTM C418, Maximum 1/16” (1.5 cu. Cm. Per 50 cu. Cm. Average thickness loss 3 mm.)
7. Dimension tolerances: Length maximum 1/16” (1.5 mm), height maximum 1.8 (3mm) from standard dimension.
8. Provide only sound units free of defects that would interfere with proper placing of units or impair strength or permanence of construction. Minor cracks and minor chipping incidental to methods of manufacture, handling in shipment, and delivery will be acceptable subject to Landscape Architect’s review and acceptance. Excessive cracks and chipping, as determined by the Landscape Architect, will be rejected as not complying with specification requirements.
9. Provide test reports certifying materials and physical requirements compliance. Tests shall have been conducted not more than 12 months prior to manufacture.
10. Paver units style, color and sizes shall be as noted on sheet L-102
11. Acceptable manufacturers shall be Concrete Stone and Tile (CST Products LLC) 345 route 130 Pedricktown, NJ 08067. Phone 856 299 5339 (or approved equal).

E. Base material: Quarry process stone as available from local quarries, free from clay, organic material, or other deleterious materials. Depth as indicated on details.

F. Bedding and leveling material: Builders Sand as available from local quarries free from clay, organic material, or other deleterious material. Depth as indicated.

G. Joint fill: Clean concrete sand or mason sand.

H. Plastic Edging for Pavers (as needed) shall be Pave Edge, Paver Edge Restraint System as manufactured by Pave Tech, Inc., or approved equal.

** END OF PART 2 **

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

D. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
   1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

E. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

3.3 PLANTING AREA ESTABLISHMENT

A. Rough grade will be left 4” below finished grade by others. Loosen subgrade of lawn areas to a minimum depth of 4”. Remove stones over 1” in any dimension and sticks, roots, rubbish and other extraneous matter and legally dispose fo them off Owner’s property. Limit preparation to areas, which will be planted promptly after preparation.

   1. Spread topsoil to minimum depth required to meet lines, grades and elevations shown, after light rolling and natural settlement (4” after settlement). Place approximately 1/2 of total amount of topsoil required. Work into top of loosened subgrade to create a transition layer and then place remains of topsoil. Add specified soil amendments (as per Section 3.19-B of this specification) and mix thoroughly into the upper 4 inches of topsoil.
   2. Where final grades are not indicated, finish grades shall be of uniform level or slope between points for which elevations are given or from such points to existing grades, except that tops and bottoms of banks shall be rounded. Subgrade elevations shall be understood to be the specified depth below finished grades.
   3. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before seeding. Do not create a muddy soil condition.
   4. Restore lawn areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

C. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45 degree angle. Excavations with vertical sides are not acceptable. Leave center bottom of excavation slightly raised at center to provide proper drainage. Ensure that root ball will sit on undisturbed base soil to prevent settling. Loosen hard subsoil in bottom of excavation.

   1. For balled and burlapped (B&B) trees and shrubs, make excavations at least the equivalent of two and a half times as wide as the ball radius and equal to the ball depth, plus the following allowance for setting of ball on a layer of compacted

backfill: Allow for 6" setting layer of planting soil mixture.

2. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
3. Do not excavate deeper than the depth of the root ball, measured from the root flare to the bottom of the root ball.
4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
5. Maintain required angles of repose of adjacent material as show on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
6. Maintain supervision of excavations during working hours.
7. Keep excavations covered or otherwise protected after working hours, overnight and when unattended by contractor's personnel.

B. Subsoil and topsoil removed from excavations MAY NOT be used as planting soil.

C. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

D. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the tip-most root emerges from the trunk. After soil removal to expose the root flare, verify that the root ball still meets size requirements.

B. Remove stem girdling roots and kinked roots, Remove injured roots by cutting cleanly; do not break.

C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 3 inches above adjacent finished grade.

1. When set, apply "Terra-Wet" to planting pit/hole as follows: Dilute 100 to 1 in cold water (1 oz. of Terra-Wet per 100 gallons of water). "Terra-Wet" may foam with agitation, to reduce foaming add an anti-foaming agent to mix as per manufacturer's recommendations.
2. Apply the solution to the excavated planting hole at the rate of 5 gallons per inch of caliper for trees and 3 gallons for 12" of root ball for shrubs. Subsequently place plant in planting hole and drench plant ball with "Terra-Wet".
3. After "Terra-Wet" application place backfill around base and sides of ball and work each layer to settle backfill and eliminate voids and air pockets.
4. During the placement of backfill place "Unique Fertilizer Packets" as specified in section 2.4 C as follows:

	Types of Plants	No. of Packets	
a.	Trees:		
	Over 4 inch caliper		4
	1 to 4 inch caliper		3
	Over 6 feet high	4	
	3 to 6 feet high		3
	15 to 36 inches high		2
	Under 15 inches high		1
b.	Shrubs:		
	Over 3 feet high	3	
	2 to 3 feet high		2
	Under 2 feet high		1

The packets shall be placed equidistantly within the planting pit adjacent to the ball or root mass, but not in direct contact with roots. Placement depth shall be 6 to 8 inches. Packets shall not be cut, ripped or damaged. If it becomes necessary to remove and replace dead or unhealthy plants, damaged or broken packets shall be replaced with new packets.

5. When excavation is approximately 2/3 full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill. Remove collar ropes only. Retain burlap on balls.

D. Set bare root stock on cushion of planting soil mixture. Spread roots, apply “Terra-Wet” to root mass by spraying. Then carefully work backfill around roots by hand and puddle with water until backfill layers are completely saturated. Plumb before backfilling and maintain plumb while working backfill around roots and placing layers above roots. Set collar 1" to 2" above adjacent finish landscape grades. Spread cut roots without tangling or turning up to surface. Cut injured roots clean, do not break.

E. Set container grown stock as specified for balled and burlapped stock, except cut cans on two sides with an approved can cutter; remove bottoms of wooden boxes after partial backfilling so as not to damage root balls.

F. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope: the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

G. Dish top of backfill to allow for mulching. For Spring planting, provide additional backfill berm around edge of excavations to form shallow saucer to collect water.

1. Note: Surface of all Shrub Beds shall be crowned or sloped as required to achieve a 3% minimum surface pitch and insure positive surface drainage.

H. Apply anti-desiccant prior to the onset of winter and again in mid-winter, using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage. If deciduous trees or

shrubs are moved in full-leaf, spray with anti-desiccant at nursery before moving and again two weeks after planting.

I. Wrap tree trunks of 2" caliper and larger. Start at ground and cover trunk to height of first branches and securely attach. Inspect tree trunks for injury, improper pruning and insect infestation and take corrective measures required before wrapping.

3.7 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches, Do not prune for Shape.

B. Prune, thin out and shape trees and shrubs in accordance with standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by the Landscape Architect, do not cut tree leaders, and remove only injured or dead branches from flowering trees, if any. Prune shrubs to retain natural character and accomplish their use in the landscape design. Required shrub sizes are the size after pruning.

1. Remove and replace excessively pruned or misformed stock resulting from improper pruning.
2. Do not apply pruning paint to wounds.

3.8 TREE STABILIZATION

A. Install trunk stabilization as follows unless otherwise indicated:

1. Upright Staking and Tying: Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend to the dimension shown on Drawings. Set vertical stakes and space to avoid penetrating root balls or root masses.
2. Use two stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper; three stakes for trees less than 14 feet high and up to 4 inches in caliper. Space stakes equally around trees.
3. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

3.11 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines 24 inches apart or as indicated in the plant schedule, in even rows with triangular spacing.

B. Use planting soil mixture for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.12 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees and tree like shrubs in Turf Areas: Apply mulch ring of 3 inch thick with 36 inch radius around trunks or stems. Do not place mulch within six inches of trunk or stems
2. Organic Mulch in Planting Areas: Apply three inches thickness of organic mulch or stone extending 12 inches beyond edge of individual planting pit or trench and over whole surface of plating area, and finish level with adjacent finished grades. Do not place mulch within three inches of trunks or stems.

3.13 EDGING INSTALLATION

A. Shovel-cut Edging. Separate mulched areas from turf areas with a 45 degree 4 to 6 inch deep, shovel cut edge.

3.15 PLANT MAINTENANCE

A. Begin maintenance immediately after planting. Maintain trees, shrubs and other plants until final acceptance, but in no case less than the following period: 60 days after planting.

B. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

C. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

D. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated past management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

E. Submit two copies of typewritten instructions recommending procedures to be established by the Owner for the maintenance of landscape work for one full year. Submit prior to the expiration of required maintenance period(s).

3.16 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

Pre-Emergent Herbicides (Selective and Non-Selective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.

Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.17 CLEANUP AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. During landscape installation, store materials and equipment where directed.

B. Protect landscape work and material from damage due to landscape operations, operations of other contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

C. After installation and before final inspection, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.18 DISPOSAL

A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

3.19 PREPARATION OF PLANTING SOIL

A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps and other extraneous materials harmful or toxic to plant growth.

B. Mix specified soil amendments at required rates (derived from Topsoil Analysis Report). Also include the following:

1. For Trees, Shrubs and all Ground covers (herbaceous and coniferous): "Terra-Sorb" AG at the rate of 32 oz. per Cubic Yard of Soil Mix.

2. For Trees and Shrubs (excluding coniferous ground cover): PHC Healthy Start 3-4-3 organic fertilizer/soil conditioner, shall be applied at 1/2 lb. per trunk diameter (cal.) inch for trees.

For shrubs as follows:

Plant Size	Rate Cups	Lbs.	# Plant Bag
1 Gallon	1/2	1/4	100
5 Gallon	1	1/2	50
15 Gallon	2	1	25
24” Ball/Box	3	1 1/2	16
36” Ball/Box	5	2 1/2	10
42” Ball/Box	6	3	8
54” Ball/Box	8	4	6
72” Ball/Box	10	5	5

C. Planting Soil Mixture: Shall consist of one part off-site topsoil, as required, one part clean coarse builder’s sand and one part humus. These shall be thoroughly mixed prior to any planting operations. The preceding shall be mixed with the soil amendments in Section 3.19 B.

E. For pit and trench type planting, mix planting soil prior to back filling and/or placing stockpile at the site.

F. For planting beds, mix planting soil either prior to planting or apply on surface of topsoil and mix thoroughly before planting.

3.20 MISCELLANEOUS LANDSCAPE CONSTRUCTION

A. Remedial Work on Existing Trees:

1. Pruning: All existing trees on the main site shall be pruned according to the best practices of the trade, making sure all the necessary limbs are removed to make a head clearance height of at least eight (8) feet under such tree or as directed. The trees shall be pruned to remove broken, dead, or dangerous limbs in accordance with “Pruning Standards For Shade Trees” as published by The National Arborists Association, adopted in 1950. Limbs to be removed shall be cut back to nearest crotch. No stubs are to remain on the tree.

2. Fertilizing Soil Amendment: All existing trees outside the wooded area shall be fertilized with a combination of Dogget’s Natural Resource and Doggett’s 32-7-7 Slow-Release Tree Fertilizer combined with Mycor Tree, Tree Saver Pt. Injectable amendment.

Apply mixture by injection into the soil/root area under hydraulic pressure. Soil injection shall be no more than 12” deep using a soil/root fertilization probe from a power sprayer. Pressure of 150 to 200 lbs. shall be more than adequate in good soils. Higher pressures may be used with care in more compacted soils.

Injection of the soil shall begin at a point out from the trunk where good site judgment deems the finer roots to be. Injections shall be spaced 2-1/2 ft. to 3 ft. apart and extend well beyond the dripline. For individual trees, injections shall follow a concentric circle type pattern.

Mixture:

Product	**Dilution**
Doggett 32-7-7	15 lbs. per 100 gal. Water
Doggett Natural Resource	1/8 lb. per 100 gal. water
Mycor Tree, Tree Saver Pt. Injectable	5 oz. per 100 gal. water

Apply mixture of fertilizer/soil amendment solution at a rate of 5 gallons of solution for every caliper inch (diameter) of tree trunk measured at breast height (5 gallons per DBH inch). This means a tree measuring 15" in diameter at breast height would require the injection of 75 gallons of solution.

B. Precast Concrete Unit Paving

1. Inspection: Examine substrates and installation conditions. Do not start precast concrete unit paving work until unsatisfactory conditions are corrected.

2. Preparation:
   a. Do not use paving units with chips, cracks, voids, discoloration, or other visible defects. .
   b. Cut paving units with motor-driven saw equipment designed to cut masonry with clean, sharp unchipped edges. Cut units as required to provide pattern shown and to fit adjoining work neatly. Use full units without cutting wherever possible. Where cutting is required, use the largest size units possible. Avoid the use of small pieces of pavers or large joint spaces.
   c. Set interlocking concrete unit pavers in patterns indicated with level surface and uniform joints of widths indicated.

3. Installation: Base Materials:
   a. Base course:
      1) Obtain Landscape Architect's inspection and acceptance of subgrade surface before placing of base course materials.
      2) Spread base course materials in layers which when compacted will not exceed 4" lifts, total compacted depth as scheduled.
      3) Compact each lift of base course materials with suitable compaction equipment to 95% of maximum dry density in accordance with ASTM D698, Standard Proctor Method.
      4) Screed, level, and shape base course surface to required grade and cross section with an allowable local tolerance of ¼".

   b. Bedding and leveling course:
      1) Obtain Landscape Architect's inspection and acceptance of finished base course before placing bedding and leveling course materials.

2) Spread bedding and leveling course materials evenly over the entire area to be paved, screed to a minimum level that will provide a minimum 2" thickness when the paving stones have been placed and vibrated.

3) Protect screened and leveled bedding and leveling course from damage until covered with paver units. Do not precompact bedding and leveling course.

4. Installation: Precast Concrete Pavers

a. Lay paver units in pattern indicated on the drawings, or when not indicated, as directed by the Landscape Architect. Maintain desired pattern and provide uniform 1/16" to 1/8" joints between units.

b. Fill gaps at the edge of the paved surface with standard edge pieces or with paver units cut to fit. Provide cut units with straight even cut surfaces, free from cracks or chips.

c. Vibrate paver units to their final level with 3 or more passes of a vibrating plate compactor.

d. After first vibration, brush sand over the surface and vibrate into the joints with additional passes of the plate vibrator. Completely fill joints.

e. After final vibrating the surface shall be true to grade and shall not vary by more than ¼" when tested with a 10'-0" straightedge at any location on the surface.

C. Plastic Edging shall be placed as necessary as per Manufacturer's instructions. Contractor shall assemble to the lines and elevations indicated.

3.21 INSPECTION & ACCEPTANCE

A. When the landscape work is completed, including maintenance, the Landscape Architect will, upon request, make an inspection to determine acceptability. The landscape work may be inspected for acceptance in parts agreeable to the Landscape Architect, provided the work offered for inspection is complete, including maintenance, and that the area comprises a complete unit or area of substantial size.

B. Where inspected landscape work does not comply with the requirements replace rejected work and continue specified maintenance until reinspected by the Landscape Architect and found to be acceptable. Remove rejected plants and material promptly from the project site.

** END OF PART 3 **
END OF SECTION

SECTION 329600 - TRANSPLANTING

1.1 SUMMARY

A. Transplanting trees by tree spade or digging and boxing.

1.2 QUALITY ASSURANCE

A. Tree-Service Firm Qualifications: Qualified landscaping contractor or tree-moving firm with qualified arborist.

1. Arborist Qualifications: Licensed arborist in jurisdiction where Project is located.

B. Tree-transplanting program prepared by arborist.

1.3 PROJECT CONDITIONS

A. Seasonal Restrictions: Transplant during in-season periods as specified.

1.4 WARRANTY

A. Installer's Special Warranty: 12 months from date of project Substantial Completion.

1.5 MAINTENANCE SERVICE

A. Initial Maintenance Service: 12 months from date of project Substantial Completion.

1.6 MATERIALS

A. Backfill Soil: Specified planting soil.

B. Tree Stabilization: Site-fabricated staking-and-guying method].

C. Watering Devices: Slow-release watering device.

D. Mulches: Shredded hardwood. According to Division 32 Section "Plants."

E. Antidesiccant.

F. Pesticides: Registered and approved by EPA, pre-emergent and post-emergent herbicide(s).

G. Planting tablets.

H. Weed-Control Barriers: Nonwoven fabric.

1.7 EXECUTION

A. Preparatory Pruning: Root pruning and crown pruning as directed by arborist.

B. Mulching: Mulch ring of 3-inch (75-mm) thickness extending 12 inches (300 mm) beyond edge of individual planting pit and over whole surface of planting area.

C. Tree Replacement: Replace trees that are 25 percent dead, unhealthy, or damaged.

END OF SECTION 329600