STATE OF DELAWARE
NEW CASTLE COUNTY VOCATIONAL TECHNICAL SCHOOL DISTRICT
CONTRACT #1907

SPECIFICATIONS
FOR

CHILLER/COOLING TOWER REFURBISHMENT

AT

DELCASTLE HIGH SCHOOL
1417 NEWPORT ROAD
WILMINGTON, DELAWARE, 19804

PREPARED
BY

GIPE ASSOCIATES, INC.
8719 BROOKS DRIVE
EASTON, MARYLAND, 21601

GIPE ASSOCIATES, INC. WORK ORDER #19003

BID DOCUMENTS
AUGUST 5, 2019

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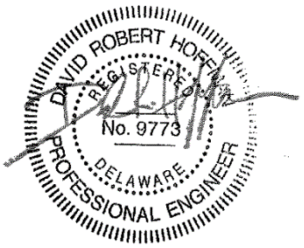
SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD SEAL

A. HVAC Engineer:



1. David R. Hoffman, P.E., LEED AP, CPD
2. Delaware Professional Engineer License #9773
3. President
4. Gipe Associates, Inc.
5. 8719 Brooks Drive
   Easton, MD 21601
6. Tel: (410) 822-8688
   Fax: (410) 822-6306
7. Email: dhoffman@gipe.net
   Cell: (410) 310-6055
8. Responsible for: Division 00, Division 01, Division 07, and Division 23

B. Electrical Engineer:

1. Dina Dixon, P.E., LEED AP
2. Delaware Professional Engineer License #17123
3. Senior Vice President
4. Gipe Associates, Inc.
5. 1220 East Joppa Road, Suite 223
   Towson, MD 21286
6. Tel: (410) 832-2420
   Fax: (410) 832-2418
7. Email: ddixon@gipe.net
   Cell: (410) 924-7232
8. Responsible for Division 26

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E-401	SCHEDULES – ELECTRICAL – NEW WORK

END OF SECTION

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INVITATION TO BID

Sealed bids for OMB/DFM Contract No. 1907, will be received by Mr. Al Schrum, Jr. at the New Castle County Vocational Technical School District's Facilities Management Office, at 1703, School Lane, Wilmington, Delaware 19808 until 1:30 pm local time on September 30, 2019, at which time they will be publicly opened and read aloud in the Conference Room. Bidder bears the risk of late delivery. Any bids received after the stated time will be returned unopened.

Project involves all labor, materials, tools, equipment, superintendence, transportation, and performing all work in strict accordance with the Specifications and Drawings for modifying the existing chiller, cooling tower, associated HVAC systems, and supporting electrical work. All work shall commence on the date of issuance of the Notice to Proceed and shall be completed and operational within one hundred eighty (150) calendar days thereafter

A **MANDATORY** Pre-Bid Meeting will be held on September 12, 2019, at 9:00am at the Delcastle High School, 1417 Newport Road, Wilmington, Delaware 19084 for the purpose of establishing the listing of subcontractors and to answer questions. Representatives of each party to any Joint Venture must attend this meeting. **ATTENDANCE OF THIS MEETING IS A PREREQUISITE FOR BIDDING ON THIS CONTRACT.**

Sealed bids shall be addressed to:
Mr. Al Schrum, Jr.
New Castle County Vocational Technical School District
Facilities Management Office
1703, School Lane
Wilmington, Delaware 19808

The outer envelope should clearly indicate: **"DELCASTLE HIGH SCHOOL CHILER/COOLING TOWER REFURBISHMENT - CONTRACT NO.1907 - SEALED BID - DO NOT OPEN."**

Contract documents may be obtained at the office of Gipe Associates, Inc. upon receipt of $50.00 per electronic set/non-refundable and/or $75 per hardcopy set/non-refundable. Checks are to be made payable to "Gipe Associates, Inc.".

Construction documents will be available for review at the following locations: Gipe Associates, Inc., 8719 Brooks Drive, Easton, Maryland; New Castle County Vocational Technical School District, 1714 Newport Road, Wilmington, Delaware 19804, and Marshalton School, 1703, School Lane, Wilmington, Delaware 19808.

Bidders will not be subject to discrimination on the basis of race, creed, color, sex, sexual orientation, gender identity or national origin in consideration of this award, and Minority Business Enterprises, Disadvantaged Business Enterprises, Women-Owned Business Enterprises and Veteran-Owned Business Enterprises will be afforded full opportunity to submit bids on this contract. Each bid must be accompanied by a bid security equivalent to ten percent of the bid amount and all additive alternates. The successful bidder must post a performance bond and payment bond in a sum equal to 100 percent of the contract price upon execution of the contract. The Owner reserves the right to reject any or all bids and to waive any informalities therein. The Owner may extend the time and place for the opening of the bids from that described in the advertisement, with not less than two calendar days notice by certified delivery, facsimile machine or other electronic means to those bidders receiving plans.

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INSTRUCTIONS TO BIDDERS

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3. BIDDING DOCUMENTS

4. BIDDING PROCEDURES

5. CONSIDERATION OF BIDS

6. POST-BID INFORMATION

7. PERFORMANCE BOND AND PAYMENT BOND

8. FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

ARTICLE 1: GENERAL

1.1 DEFINITIONS

1.1.1 Whenever the following terms are used, their intent and meaning shall be interpreted as follows:

1.2 STATE: The State of Delaware.

1.3 AGENCY: Contracting State Agency as noted on cover sheet.

1.4 DESIGNATED OFFICIAL: The agent authorized to act for the Agency.

1.5 BIDDING DOCUMENTS: Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement for Bid, Invitation to Bid, Instructions to Bidders, Supplementary Instructions to Bidders (if any), General Conditions, Supplementary General Conditions, General Requirements, Special Provisions (if any), the Bid Form (including the Non-collusion Statement), and other sample bidding and contract forms. The proposed Contract Documents consist of the form of Agreement between the Owner and Contractor, as well as the Drawings, Specifications (Project Manual) and all Addenda issued prior to execution of the Contract.

1.6 CONTRACT DOCUMENTS: The Contract Documents consist of the, Instructions to Bidders, Supplementary Instructions to Bidders (if any), General Conditions, Supplementary General Conditions, General Requirements, Special Provisions (if any), the form of agreement between the Owner and the Contractor, Drawings (if any), Specifications (Project Manual), and all addenda.

1.7 AGREEMENT: The form of the Agreement shall be AIA Document A101, Standard Form of Agreement between Owner and Contractor where the basis of payment is a STIPULATED SUM. In the case of conflict between the instructions contained therein and the General Requirements herein, these General Requirements shall prevail.

1.8 GENERAL REQUIREMENTS (or CONDITIONS): General Requirements (or conditions) are instructions pertaining to the Bidding Documents and to contracts in general. They contain, in summary, requirements of laws of the State; policies of the Agency and instructions to bidders.

1.9 SPECIAL PROVISIONS: Special Provisions are specific conditions or requirements peculiar to the bidding documents and to the contract under consideration and are supplemental to the General Requirements. Should the Special Provisions conflict with the General Requirements, the Special Provisions shall prevail.

1.10 ADDENDA: Written or graphic instruments issued by the Owner/Architect prior to the execution of the contract which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.

1.11 BIDDER OR VENDOR: A person or entity who formally submits a Bid for the material or Work contemplated, acting directly or through a duly authorized representative who meets the requirements set forth in the Bidding Documents.

1.12 SUB-BIDDER: A person or entity who submits a Bid to a Bidder for materials or labor, or both for a portion of the Work.

1.13 BID: A complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

1.14 BASE BID: The sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids (if any are required to be stated in the bid).

1.15 ALTERNATE BID (or ALTERNATE): An amount stated in the Bid, where applicable, to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents is accepted.

1.16 UNIT PRICE: An amount stated in the Bid, where applicable, as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.

1.17 SURETY: The corporate body which is bound with and for the Contract, or which is liable, and which engages to be responsible for the Contractor's payments of all debts pertaining to and for his acceptable performance of the Work for which he has contracted.

1.18 BIDDER'S DEPOSIT: The security designated in the Bid to be furnished by the Bidder as a guaranty of good faith to enter into a contract with the Agency if the Work to be performed or the material or equipment to be furnished is awarded to him.

1.19 CONTRACT: The written agreement covering the furnishing and delivery of material or work to be performed.

1.20 CONTRACTOR: Any individual, firm or corporation with whom a contract is made by the Agency.

1.21 SUBCONTRACTOR: An individual, partnership or corporation which has a direct contract with a contractor to furnish labor and materials at the job site, or to perform construction labor and furnish material in connection with such labor at the job site.

1.22 CONTRACT BOND: The approved form of security furnished by the contractor and his surety as a guaranty of good faith on the part of the contractor to execute the work in accordance with the terms of the contract.

1.23 Whenever the word “Architect” shall appear on standard printed documents published by the American Institute of Architects (AIA), it shall mean “Engineer” and shall refer to Gipe Associates, Inc. or its appointed staff or sub-consultant.

1.24 Wherever the word “Owner” shall appear on standard printed document published by the American Institute of Architects (AIA), it shall mean the New Castle County Votech School District.

ARTICLE 2: BIDDER'S REPRESENTATIONS

2.1 PRE-BID MEETING

2.1.1 A pre-bid meeting for this project will be held at the time and place designated. Attendance at this meeting is a pre-requisite for submitting a Bid, unless this requirement is specifically waived elsewhere in the Bid Documents.

2.2 By submitting a Bid, the Bidder represents that:

2.2.1 The Bidder has read and understands the Bidding Documents and that the Bid is made in accordance therewith.

2.2.2 The Bidder has visited the site, become familiar with existing conditions under which the Work is to be performed, and has correlated the Bidder's his personal observations with the requirements of the proposed Contract Documents.

2.2.3 The Bid is based upon the materials, equipment, and systems required by the Bidding Documents without exception.

2.3 JOINT VENTURE REQUIREMENTS

2.3.1 For Public Works Contracts, each Joint Venturer shall be qualified and capable to complete the Work with their own forces.

2.3.2 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 Venturers involved.

2.3.3 All required Bid Bonds, Performance Bonds, Material and Labor Payment Bonds must be executed by both Joint Venturers and be placed in both of their names.

2.3.4 All required insurance certificates shall name both Joint Venturers.

2.3.5 Both Joint Venturers shall sign the Bid Form and shall submit a copy of a valid Delaware Business License with their Bid.

2.3.6 Both Joint Venturers shall include their Federal E.I. Number with the Bid.

2.3.7 In the event of a mandatory Pre-bid Meeting, each Joint Venturer shall have a representative in attendance.

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

2.4 ASSIGNMENT OF ANTITRUST CLAIMS

2.4.1 As consideration for the award and execution by the Owner of this contract, the Contractor hereby grants, conveys, sells, assigns and transfers to the State of Delaware all of its right, title and interests in and to all known or unknown causes of action it presently has or may now or hereafter acquire under the antitrust laws of the United States and the State of Delaware, relating to the particular goods or services purchased or acquired by the Owner pursuant to this contract.

ARTICLE 3: BIDDING DOCUMENTS

3.1 COPIES OF BID DOCUMENTS

3.1.1 Bidders may obtain complete sets of the Bidding Documents from the Architectural/Engineering firm designated in the Advertisement or Invitation to Bid in the number and for the deposit sum, if any, stated therein.

3.1.2 Bidders shall use complete sets of Bidding Documents for preparation of Bids. The issuing Agency nor the Architect assumes no responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

3.1.3 Any errors, inconsistencies or omissions discovered shall be reported to the Architect immediately.

3.1.4 The Agency and Architect may make copies of the Bidding Documents available on the above terms for the purpose of obtaining Bids on the Work. No license or grant of use is conferred by issuance of copies of the Bidding Documents.

3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

3.2.1 The Bidder shall carefully study and compare the Bidding Documents with each other, and with other work being bid concurrently or presently under construction to the extent that it relates to the Work for which the Bid is submitted, shall examine the site and local conditions, and shall report any errors, inconsistencies, or ambiguities discovered to the Architect.

3.2.2 Bidders or Sub-bidders requiring clarification or interpretation of the Bidding Documents shall make a written request to the Architect at least seven days prior to the date for receipt of Bids. Interpretations, corrections and changes to the Bidding Documents will be made by written Addendum. Interpretations, corrections, or changes to the Bidding Documents made in any other manner shall not be binding.

3.2.2a Direct inquires and request for information (AIA G716) to: Gipe Associates, Inc. ATTN David R. Hoffman, P.E., Email: dhoffman@gipe.net; Fax: 410-822-6306 no later than seven (7) days prior to bid due date.

3.2.3 The apparent silence of the specifications as to any detail, or the apparent omission from it of detailed description concerning any point, shall be regarded as meaning that only the best commercial practice is to prevail and only material and workmanship of the first quality are to be used. Proof of specification compliance will be the responsibility of the Bidder.

3.2.4 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for all permits, labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work.

3.2.5 The Owner will bear the costs for all impact and user fees associated with the project.

3.3 SUBSTITUTIONS

3.3.1 The materials, products and equipment described in the Bidding Documents establish a standard of quality, required function, dimension, and appearance to be met by any proposed substitution. The specification of a particular manufacturer or model number is not intended to be proprietary in any way. Substitutions of products for those named will be considered, providing that the Vendor certifies that the function, quality, and performance characteristics of the material offered is equal or superior to that specified. It shall be the Bidder's responsibility to assure that the proposed substitution will not affect the intent of the design, and to make any installation modifications required to accommodate the substitution.

3.3.2 Requests for substitutions shall be made in writing to the Architect at least ten days prior to the date of the Bid Opening. Such requests shall include a complete description of the proposed substitution, drawings, performance and test data, explanation of required installation modifications due the substitution, and any other information necessary for an evaluation. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval shall be final. The Architect is to notify Owner prior to any approvals.

3.3.3 If the Architect approves a substitution prior to the receipt of Bids, such approval shall be set forth in an Addendum. Approvals made in any other manner shall not be binding.

3.3.4 The Architect shall have no obligation to consider any substitutions after the Contract award.

3.3.5 Refer to Section 016000 "Product Requirements Substitutions for additional requirement and procedures regarding substitutions.

3.4 ADDENDA

3.4.1 Addenda will be mailed or delivered to all who are known by the Architect to have received a complete set of the Bidding Documents.

3.4.2 Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

3.4.3 No Addenda will be issued later than 4 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.

3.4.4 Each bidder shall ascertain prior to submitting his Bid that they have received all Addenda issued, and shall acknowledge their receipt in their Bid in the appropriate space. Not acknowledging an issued Addenda could be grounds for determining a bid to be non-responsive.

ARTICLE 4: BIDDING PROCEDURES

4.1 PREPARATION OF BIDS

4.1.1 Submit the bids on the Bid Forms included with the Bidding Documents.

4.1.2 Submit the original Bid Form for each bid. Bid Forms may be removed from the project manual for this purpose.

4.1.3 Execute all blanks on the Bid Form in a non-erasable medium (typewriter or manually in ink).

4.1.4 Where so indicated by the makeup on the Bid Form, express sums in both words and figures, in case of discrepancy between the two, the written amount shall govern.

4.1.5 Interlineations, alterations or erasures must be initialed by the signer of the Bid.

4.1.6 BID ALL REQUESTED ALTERNATES AND UNIT PRICES, IF ANY. If there is no change in the Base Bid for an Alternate, enter "No Change". The Contractor is responsible for verifying that they have received all addenda issued during the bidding period. Work required by Addenda shall automatically become part of the Contract.

4.1.7 Make no additional stipulations on the Bid Form and do not qualify the Bid in any other manner.

4.1.8 Each copy of the Bid shall include the legal name of the Bidder and a statement whether the Bidder is a sole proprietor, a partnership, a corporation, or any legal entity, and each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further give the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current Power of Attorney attached, certifying agent's authority to bind the Bidder.

4.1.9 Bidder shall complete the Non-Collusion Statement form included with the Bid Forms and include it with their Bid.

4.1.10 In the construction of all Public Works projects for the State of Delaware or any agency thereof, 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.

4.1.11 Each bidder shall include in their bid a copy of a valid Delaware Business License.'

4.1.12 Each bidder shall include a signed Affidavit for the Bidder certifying compliance with OMB Regulation 4104 - "Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on "Large Public Works Projects." "Large Public Works" is based upon the current threshold required for bidding Public Works as set by the Purchasing and Contracting Advisory Council.

4.2 BID SECURITY

4.2.1 All bids shall be accompanied by a deposit of either a good and sufficient bond to the agency for the benefit of the agency, with corporate surety authorized to do business in this State, the form of the bond and the surety to be approved by the agency, or a security of the bidder assigned to the agency, for a sum equal to at least 10% of the bid plus all add alternates, or in lieu of the bid bond a security deposit in the form of a certified check, bank treasurer's check, cashier's check, money order, or other prior approved secured deposit assigned to the State. The bid bond need not be for a specific sum, but may be stated to be for a sum equal to 10% of the bid plus all add alternates to which it relates and not to exceed a certain stated sum, if

said sum is equal to at least 10% of the bid. The Bid Bond form used shall be the standard OMB form (attached).

4.2.2 The Agency has the right to retain the bid security of Bidders to whom an award is being considered until either a formal contract has been executed and bonds have been furnished or the specified time has elapsed so the Bids may be withdrawn or all Bids have been rejected.

4.2.3 In the event of any successful Bidder refusing or neglecting to execute a formal contract and bond within 20 days of the awarding of the contract, the bid bond or security deposited by the successful bidder shall be forfeited.

4.3 SUBCONTRACTOR LIST

4.3.1 As required by Delaware Code, Title 29, section 6962(d)(10)b, each Bidder shall submit with their Bid a completed List of Sub-Contractors included with the Bid Form. NAME ONLY ONE SUBCONTRACTOR FOR EACH TRADE. A Bid will be considered non-responsive unless the completed list is included.

4.3.2 Provide the Name and Address for each listed subcontractor. Addresses by City, Town or Locality, plus State, will be acceptable.

4.3.3 It is the responsibility of the Contractor to ensure that their Subcontractors are in compliance with the provisions of this law. Also, if a Contractor elects to list themselves as a Subcontractor for any category, they must specifically name themselves on the Bid Form and be able to document their capability to act as Subcontractor in that category in accordance with this law.

4.4 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

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

A. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, sex, color, sexual orientation, gender identity 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, sex, color, sexual orientation, gender identity 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.

B. 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, sex, color, sexual orientation, gender identity or national origin."

4.5 PREVAILING WAGE REQUIREMENT

4.5.1 Wage Provisions: For renovation and new construction projects whose costs exceed the thresholds contained in Delaware Code, Title 29, Section 6960, 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.

4.5.2 The employer 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.

4.5.3 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.

4.5.4 Every contract based upon these specifications shall contain a stipulation that sworn payroll information, as required by the Department of Labor, be furnished weekly. The 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.

4.6 SUBMISSION OF BIDS

4.6.1 Enclose the Bid, the Bid Security, and any other documents required to be submitted with the Bid in a sealed opaque envelope. Address the envelope to the party receiving the Bids. Identify with the project name, project number, and the Bidder's name and address. If the Bid is sent by mail, enclose the sealed envelope in a separate mailing envelope with the notation "BID ENCLOSED" on the face thereof. The State is not responsible for the opening of bids prior to bid opening date and time that are not properly marked.

4.6.2 Deposit Bids at the designated location prior to the time and date for receipt of bids indicated in the Advertisement for Bids. Bids received after the time and date for receipt of bids will be marked “LATE BID” and returned.

4.6.3 Bidder assumes full responsibility for timely delivery at location designated for receipt of bids.

4.6.4 Oral, telephonic or telegraphic bids are invalid and will not receive consideration.

4.6.5 Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids, provided that they are then fully in compliance with these Instructions to Bidders.

4.7 MODIFICATION OR WITHDRAW OF BIDS

4.7.1 Prior to the closing date for receipt of Bids, a Bidder may withdraw a Bid by personal request and by showing proper identification to the Architect. A request for withdraw by letter or fax, if the Architect is notified in writing prior to receipt of fax, is acceptable. A fax directing a modification in the bid price will render the Bid informal, causing it to be ineligible for consideration of award. Telephone directives for modification of the bid price shall not be permitted and will have no bearing on the submitted proposal in any manner.

4.7.2 Bidders submitting Bids that are late shall be notified as soon as practicable and the bid shall be returned.

4.7.3 A Bid may not be modified, withdrawn or canceled by the Bidder during a thirty (30) day period following the time and date designated for the receipt and opening of Bids, and Bidder so agrees in submitting their Bid. Bids shall be binding for thirty (30) days after the date of the Bid opening.

ARTICLE 5: CONSIDERATION OF BIDS

5.1 OPENING/REJECTION OF BIDS

5.1.1 Unless otherwise stated, Bids received on time will be publicly opened and will be read aloud. An abstract of the Bids will be made available to Bidders.

5.1.2 The Agency shall have the right to reject any and all Bids. A Bid not accompanied by a required Bid Security or by other data required by the Bidding Documents, or a Bid which is in any way incomplete or irregular is subject to rejection.

5.1.3 If the Bids are rejected, it will be done within thirty (30) calendar day of the Bid opening.

5.2 COMPARISON OF BIDS

5.2.1 After the Bids have been opened and read, the bid prices will be compared and the result of such comparisons will be made available to the public. Comparisons of the Bids may be based on the Base Bid plus desired Alternates. The Agency shall have the right to accept Alternates in any order or combination.

5.2.2 The Agency reserves the right to waive technicalities, to reject any or all Bids, or any portion thereof, to advertise for new Bids, to proceed to do the Work otherwise, or to abandon the Work, if in the judgment of the Agency or its agent(s), it is in the best interest of the State.

5.2.3 An increase or decrease in the quantity for any item is not sufficient grounds for an increase or decrease in the Unit Price.

5.2.4 The prices quoted are to be those for which the material will be furnished F.O.B. Job Site and include all charges that may be imposed during the period of the Contract.

5.2.5 No qualifying letter or statements in or attached to the Bid, or separate discounts will be considered in determining the low Bid except as may be otherwise herein noted. Cash or separate discounts should be computed and incorporated into Unit Bid Price(s).

5.3 DISQUALIFICATION OF BIDDERS

5.3.1 An agency shall determine that each Bidder on any Public Works Contract is responsible before awarding the Contract. Factors to be considered in determining the responsibility of a Bidder include:

A. The Bidder’s financial, physical, personnel or other resources including Subcontracts;

B. The Bidder’s record of performance on past public or private construction projects, including, but not limited to, defaults and/or final adjudication or

admission of violations of the Prevailing Wage Laws in Delaware or any other state;

C. The Bidder's written safety plan;

D. Whether the Bidder is qualified legally to contract with the State;

E. Whether the Bidder supplied all necessary information concerning its responsibility; and,

F. Any other specific criteria for a particular procurement, which an agency may establish; provided however, that, the criteria be set forth in the Invitation to Bid and is otherwise in conformity with State and/or Federal law.

5.3.2 If an agency determines that a Bidder is nonresponsive and/or nonresponsible, the determination shall be in writing and set forth the basis for the determination. A copy of the determination shall be sent to the affected Bidder within five (5) working days of said determination.

5.3.3 In addition, any one or more of the following causes may be considered as sufficient for the disqualification of a Bidder and the rejection of their Bid or Bids.

5.3.3.1 More than one Bid for the same Contract from an individual, firm or corporation under the same or different names.

5.3.3.2 Evidence of collusion among Bidders.

5.3.3.3 Unsatisfactory performance record as evidenced by past experience.

5.3.3.4 If the Unit Prices are obviously unbalanced either in excess or below reasonable cost analysis values.

5.3.3.5 If there are any unauthorized additions, interlineation, conditional or alternate bids or irregularities of any kind which may tend to make the Bid incomplete, indefinite or ambiguous as to its meaning.

5.3.3.6 If the Bid is not accompanied by the required Bid Security and other data required by the Bidding Documents.

5.3.3.7 If any exceptions or qualifications of the Bid are noted on the Bid Form.

5.4 ACCEPTANCE OF BID AND AWARD OF CONTRACT

5.4.1 A formal Contract shall be executed with the successful Bidder within twenty (20) calendar days after the award of the Contract.

5.4.2 Per Section 6962(d)(13) a., Title 29, Delaware Code, "The contracting agency shall award any public works contract within thirty (30) days of the bid opening to the lowest responsive and responsible Bidder, unless the Agency elects to award on the basis of best value, in which case the election to award on the basis of best value shall be stated in the Invitation To Bid."

5.4.3 Each Bid on any Public Works Contract must be deemed responsive by the Agency to be considered for award. A responsive Bid shall conform in all material respects to the requirements and criteria set forth in the Contract Documents and specifications.

5.4.4 The Agency shall have the right to accept Alternates in any order or combination, and to determine the low Bidder on the basis of the sum of the Base Bid, plus accepted Alternates.

5.4.5 The successful Bidder shall execute a formal contract, submit the required Insurance Certificate, and furnish good and sufficient bonds, unless specifically waived in the General Requirements, in accordance with the General Requirement, within twenty (20) days of official notice of contract award. The successful Bidder shall provide, at least two business days prior to contract execution, copies of the Employee Drug Testing Program for the Bidder and all listed Subcontractors. Bonds shall be for the benefit of the Agency with surety in the amount of 100% of the total contract award. Said Bonds shall be conditioned upon the faithful performance of the contract. Bonds shall remain in affect for period of one year after the date of substantial completion.

5.4.6 If the successful Bidder fails to execute the required Contract, Bond and all required information, as aforesaid, within twenty (20) calendar 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.

5.4.7 Each bidder shall supply with its bid its taxpayer identification number (i.e., federal employer identification number or social security number) and a copy of its Delaware business license, and should the vendor be awarded a contract, such vendor shall provide to the agency the taxpayer identification license numbers of such subcontractors. Such numbers shall be provided on the later of the date on which such subcontractor is required to be identified or the time the contract is executed. The successful Bidder shall provide to the agency to which it is contracting, within thirty (30) days of entering into such public works contract, copies of all Delaware Business licenses of subcontractors and/or independent contractors that will perform work for such public works contract. However, if a subcontractor or independent contractor is hired or contracted more than twenty (20) days after the Bidder entered the public works contract the Delaware Business license of such subcontractor or independent contractor shall be provided to the agency within ten (10) days of being contracted or hired.

5.4.8 The Bid Security shall be returned to the successful Bidder upon the execution of the formal contract. The Bid Securities of unsuccessful bidders shall be returned within thirty (30) calendar days after the opening of the Bids.

ARTICLE 6: POST-BID INFORMATION

6.1 CONTRACTOR'S QUALIFICATION STATEMENT

6.1.1 Bidders to whom award of a Contract is under consideration shall, if requested by the Agency, submit a properly executed AIA Document A305, Contractor's Qualification Statement, unless such a statement has been previously required and submitted.

6.2 BUSINESS DESIGNATION FORM

6.2.1 Successful bidder shall be required to accurately complete an Office of Management and Budget Business Designation Form for Subcontractors.

ARTICLE 7: PERFORMANCE BOND AND PAYMENT BOND

7.1 BOND REQUIREMENTS

7.1.1 The cost of furnishing the required Bonds, which are stipulated in the Bidding Documents, shall be included in the Bid.

7.1.2 If the Bidder is required by the Agency to secure a bond from other than the Bidder's usual sources, changes in cost will be adjusted as provide in the Contract Documents.

7.1.3 The Performance and Payment Bond forms used shall be the standard OMB forms (attached).

7.2 TIME OF DELIVERY AND FORM OF BONDS

7.2.1 The bonds shall be dated on or after the date of the Contract.

7.2.2 The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix a certified and current copy of the power of attorney.

ARTICLE 8: FORM OF AGREEMENT BETWEEN AGENCY AND CONTRACTOR

8.1 Unless otherwise required in the Bidding Documents, the Agreement for the Work will be written on AIA Document A101, Standard Form of Agreement Between Owner and Contractor Where the Basis of Payment is a Stipulated Sum.

ARTICLE 9: ADDITIONAL INSTRUCTIONS TO BIDDERS

9.1 Time of Completion: The Owner desires substantial completion of total project to be no later than one hundred twenty (120) calendar days from Notice to Proceed and final completion thirty (30) calendar days thereafter (total contract time is one hundred fifty (150) days). This provision is of the essence.

9.2 Liquidated Damages: Liquidated damages shall be assessed to compensate the Owner by the contractor to compensate the Owner's cost associated with late completion of the project. Liquidated damages shall be deducted from the final payment utilizing a change order. Refer to the Bid Form and Supplementary Conditions for additional information.

END OF SECTION

AVAILABLE INFORMATION

The available information is for the bidder's use in preparing bids, but is not part of the Contract Documents and does not relieve the bidder from doing his own investigations to determine the accuracy of the information. The information provided includes:

- A copy of the existing original chiller submittal (enclosed as "Information Available to Bidders").

- A copy of the existing original Marley cooling tower submittal (enclosed as "Information Available to Bidders").

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Stockton Mechanical Contractors, Inc.
Approved
Approved as noted
By HES
Date 8/10/00

RECEIVED
AUG 11 2000
D. J. VERVERELLI, INC.

DEL CASTLE CHILLER

YORK Millenium Chiller

YORK INTERNATIONAL CORPORATION

☐ REVIEWED ☐ REVISE AND RESUBMIT
☐ REJECTED ☒ FURNISH AS CORRECTED
☐ SUBMIT SPECIFIED ITEM

Corrections or comments made on the shop drawing during this review do not relieve contractor from com plance with requirements of the drawings an specifications. This check is only for review of genera conformance with the design concept of the proje and general compliance with the information given. the contract documents. The contractor is responsib for: confirming and correlating all quantities a dimensions; selecting fabrication processes a techniques of construction; coordinating his work wi that of all other trades; and performing his work in a safe and satisfactory manner.

D. J. VERVERELLI, INC.
CONSULTING ENGINEERS
PHILADELPHIA, PA.
Date 8/21/00 By WLM

SUBMITTED TO
Stockton Mechanical

SUBMITTED FOR
Approval

SUBMITTED
August 2, 2000

SUBMITTED BY
YORK International
Sales Division
75 Great Valley Parkway
Malvern, PA 19355
800-528-YORK

FOR INFORMATION CONTACT
Richard Robus
800-528-9675

M

YORK INTERNATIONAL CORPORATION

Philadelphia Applied Systems
75 Great Valley Parkway
Malvern, PA 19355
800-528-YORK

SUBMITTAL TRANSMISSION SHEET

DATE:	July 31, 2000
PROJECT:	Del-Castle Chiller
YOUR ORDER #	Signed Quote
YORK CONTRACT #	00-111,034
YORK ORDER #	01

SECTION #:	DESCRIPTION:
	YORK YK Millenium Chiller
	Written Specifications
	Performance Specifications
	Unit Drawing
	Wiring Diagram – Field Connections
	Wiring Diagram – Field Control Modifications
	Refrigerant Monitor
	Engineering Guide
	Form 7 Reassemble

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SECTION 1

YORK YK Millenium Chiller

DEL CASTLE CHILLER

YORK® INTERNATIONAL
CORPORATION

Philadelphia Applied Systems
75 Great Valley Parkway
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800-528-YORK

SECTION 1

Written Specification

DEL CASTLE CHILLER

YORK®

YK MILLENNIUM CHILLER
Del Castle Chiller

General
Furnish YORK Millennium Centrifugal Liquid Chilling-Unit as indicated on the drawings.

Each unit will be completely factory-packaged including evaporator, condenser, compressor, open motor, lubrication system, ISN Control Center and all interconnecting unit piping and wiring. The chiller will be painted prior to shipment.

Performance will be certified in accordance with ARI Standard 550-92. Only chillers that are listed in the ARI Certification Program for Centrifugal and Rotary Screw Water Chillers are acceptable.

The initial charge of refrigerant and oil will be supplied for each unit.

Compressor
The compressor will be a single-stage centrifugal type powered by an open-drive electric motor. The housing will be fully accessible with vertical circular joints, with the complete operating assembly removable from the compressor and scroll housing. Compressor castings will be designed for 180 psig working pressure and hydrostatically pressure tested at 270 psig for R-134a units. The rotor assembly will consist of a heat-treated alloy steel drive shaft and impeller shaft with a cast aluminum, fully shrouded impeller. The impeller will be designed for balanced thrust, dynamically balanced and overspeed tested for smooth, vibration-free operation. Insert-type journal and thrust bearings will be fabricated of aluminum alloy, precision bored and axially grooved.

Internal single helical gears with crowned teeth will be designed so that more than one tooth is in contact at all times to provide even distribution of compressor load and quiet operation. Each gear will be individually mounted in its own journal and thrust bearings to isolate it from impeller and motor forces. The shaft seal will be a spring-loaded carbon ring with precision lapped collar cooled by oil during operation. A gravity-fed oil reservoir will be built into the top of the compressor to provide lubrication during coastdown in the event of a power failure.

Capacity control will be achieved by use of prerotation vanes to provide fully modulating control from maximum to minimum load. The unit will be capable of operating with lower temperature cooling tower water during part-load operation in accordance with ARI Standard 550. Prerotation vane position will be automatically controlled by an external electric actuator to maintain constant leaving chilled water temperature.

Lubrication System
Lubrication oil will be force-fed to all bearings, gears and rotating surfaces by an oil pump which operates prior to startup, continuously during operation and during coastdown. An oil reservoir, separate from the compressor, will contain a submersible oil pump and immersion-type oil heater, thermostatically controlled to boil off refrigerant from the oil. Oil will be filtered by an externally mounted replaceable cartridge oil filter equipped with service valves and cooled by a refrigerant-cooled oil cooler before entering the compressor. Oil piping will be completely factory installed and tested.

Motor Driveline
The compressor motor will be an open drip-proof, squirrel cage, induction type operating at 3570 RPM.

The open motor will be provided with a D-flange, to allow it to be rigidly coupled to the compressor to provide factory alignment of motor and compressor shafts, and to allow access to motor for repair without first removing refrigerant charge from the chiller.

Motor drive shaft will be directly connected to the compressor shaft with a flexible disc coupling. Coupling will have all metal construction with no wearing parts to assure long life, and no lubrication requirements to provide low maintenance.

For units utilizing remote electro-mechanical starters, a large steel terminal box with gasketed front access cover will be provided for field connected conduit. Overload/overcurrent transformers will be furnished with all units. (For units furnished with factory packaged Solid State Starters, refer to the options section.)

Condenser
Condenser will be of the shell-and-tube type, designed for 265 psig working pressure on the refrigerant side, and will be tested at 400 psig. Shell will be fabricated from rolled carbon steel plate with fusion welded seams; have carbon steel tube sheets, drilled and reamed to accommodate the tubes; and intermediate tube supports spaced no more than four feet apart. The refrigerant side will be designed, tested and stamped in accordance with ASME Boiler and Pressure Vessel Code, Section VIII- Division 1. Tubes shall be high-efficiency, internally and externally enhanced type having plain copper lands at all intermediate tube supports to provide maximum tube wall thickness at the support area. Each tube will be roller expanded into the tube sheets providing a leak-proof seal, and be individually replaceable. Water velocity through the tubes will not exceed 12 FPS.

Evaporator
Evaporator will be of the shell-and-tube, flooded type designed for 265 psig working pressure on the refrigerant side, and be tested at 400 psig. Shell will be fabricated from rolled carbon steel plate with fusion welded seams; have carbon steel tube sheets, drilled and reamed to accommodate the tubes; and intermediate tube supports spaced no more than four feet apart. The refrigerant side will be designed, tested and stamped in accordance with ASME Boiler and Pressure Vessel Code, Section VIII- Division 1. Tubes shall be high-efficiency, internally and externally enhanced type having plain copper lands at all intermediate tube supports to provide maximum tube wall thickness at the support area. Each tube will be roller expanded into the tube sheets providing a leak-proof seal, and be individually replaceable. Water velocity through the tubes will not exceed 12 FPS. Two liquid level sight glasses will be located on the side of the shell to aid in determining proper refrigerant charge. Aluminum mesh eliminators will be located above the tube bundle to prevent liquid refrigerant carryover to the compressor. The evaporator will have a refrigerant relief device sized to meet the requirements of ASHRAE 15 Safety Code for Mechanical Refrigeration.

Refrigerant Flow Control
Refrigerant flow to the evaporator will be controlled by a variable orifice for improving unloading capabilities.

Startup and Operator Training
The services of a factory trained, field service representative will be provided to supervise the final leak testing, charging and the initial startup and conduct concurrent operator instruction.

Marine Water Boxes - Condenser
Marine Water Boxes will be supplied on the condenser water circuit. They will be of fabricated steel construction with a removable, bolted-on cover plate. The water connections will be pipe stubs with Victaulic grooves. The connections will be capped for shipment. Plugged 1/2" NPTI couplings will be provided for vent and drain connections.

The 1-pass arrangement will have a marine water box at both ends.

Differential Pressure Switch
Differential pressure switch will be supplied for the evaporator and condenser circuit. The switch will conform to NEMA 4X watertight enclosure. The switch will have a 300 psig DWP with a 0-40 PSID range. The switch will be equipped with a 1/4" NPTI pressure connection, brass bellows, auto-reset, and Class B SPDT switch with a 5 amp at 115V rating. The switch will be shipped loose for contractor field installation.

COMPRESSOR MOTOR STARTER

YORK will furnish a reduced-voltage, liquid-cooled Solid State Starter, factory-mounted on the centrifugal liquid chilling unit. The starter enclosure will be NEMA-1 and will be of modular construction with complete access to all parts without disturbing the refrigerant circuit. Power wiring from the starter to the compressor motor and control wiring from the starter to the chiller control panel will be completed at the factory. The starter will be tested and the design starting current and overload settings will be adjusted at the factory. The starter will provide, through the use of six silicon controlled rectifiers (2 per phase), a smooth acceleration of the motor without current transitions or transients.

The following protective devices items will be factory mounted and wired to the starter:

1. 3-leg sensing electronic overloads with indicating lights and reset button - will shut unit down if current exceeds 105% of FLA to protect the motor windings.

2. Phase rotation protection circuit and indicating light - will deny start-up when detecting incorrect power wiring phase sequence to the starter which could cause reverse motor rotation and damage the equipment.

3. Single-phase failure protection circuit and indicating light - will insure against motor burnout by shutting the unit down if power loss occurs in any of the incoming lines during start- up.

4. High temperature safety protection system with indicating light and reset button - thermistors embedded on heat sinks will shut the unit down if the SCR temperature exceeds acceptable limits.

5. Hinged access door with lock and keys - will prevent tampering by unauthorized personnel.

6. High and low line voltage protection.

The following convenience items will be factory mounted and wired to the starter:

1. Auxiliary 1-1/2 KVA transformer - will eliminate the need for running separate 115V-1ph-50/60 Hz power source wiring to the Millennium Control Center. Available primaries: 60 Hz - 200/208V, 240/480V or 550/600V 50 Hz - 380/400/415V

2. The 208 V power to the oil pump will be factory wired to the starter.

3. Digital Elapsed Time Meter - will easily keep track of operating hours to gauge regular maintenance and inspection requirements.

4. Power Fault Protection - momentary power interruption protection detects power interruptions within 3/4 line cycle and will interrupt power to the compressor motor within 4 line cycles.

5. Electrical lugs - these tin-plated lugs will provide easy connection to incoming copper power lines.

6. 3-phase digital ammeter and digital voltmeter readout via control center - will easily cross- check design current and voltage limitations against supply characteristics. Meter readings (selected in accordance with starter selection) amps: 0-750, 0-1500, 0-2800, 0-3500 volts: 0-300, 0-700

Shipment Form #7 – Split Shells
Shipped as three major assemblies. Unit first factory assembled, refrigerant piped, wired, and leak tested; then dismantled for shipment. Close Coupled compressor / open motor assembly removed from shells and skidded.

Evaporator and condenser shells are separated at tube sheets and are not skidded. Refrigerant lines between shells are flanged and capped, requiring no welding. Tube sheets are also bolted, requiring no welding.

All openings on compressor and shells are closed and charged with dry nitrogen (2 to 3 psig).

Miscellaneous packaging of control center, oil eductor filter, tubing, water temperature controls, wiring, oil, isolators, solid state starter (option), etc. Refrigerant charge shipped separately in cylinders as required by amount of operating charge.

NOTE: The chiller will carry the UL Label.

CHILLER REASSEMBLY
Chiller will be reassembled by York Technicians. Mechanical Contractor is responsible for rigging pieces into the final assembly area. York Service Technicians will reassemble the Chiller into it's final location and leak test the chiller for tightness.

WARRANTY
YORK provides first year parts and labor warranty on the detailed Centrifugal Chiller(s) which includes repair or replacement, at YORK'S option, of defective warranted parts during the warranty period. This warranty does not include troubleshooting labor, nor does it include normal preventative maintenance services such as oil or filter changes. The warranty period is defined as one year from start-up or 18 months from shipping date; whichever occurs first. Refrigerant is also included during the warranty period.

ITEMS NOT INCLUDED

- Rigging and Providing Access for Equipment
- Valves for vents or drains
- Pressure gauges for chilled water lines
- Relief piping to atmosphere
- Insulation of water boxes
- Insulation of chiller
- Lightning or surge protector
- Breathing Apparatus

YORK® INTERNATIONAL
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Philadelphia Applied Systems
75 Great Valley Parkway
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800-528-YORK

SECTION 1

Performance Specification

DEL CASTLE CHILLER

YORK®

YK MILLENNIUM CHILLER PERFORMANCE SPECIFICATION

Unit Tag	Qty.	Model No.	Capacity (tons)	Volts/Ph/Hz	Refrigerant
CH - 1	1	YKCBDBG4-CLE	357	208/3/60	R-134A

Unit Data	Evaporator	Condenser
EWT (deg F.)	53.40	85.00
LWT (deg F.)	45.00	94.29
Flow Rate (gpm)	1020.0	1080.0
Pressure Drop (ft)	5.9	17.4
Fluid Type (%)	WATER	WATER
Circuit # of Passes	1	2
Fouling Factor (ft² °F hr / Btu)	0.00010	0.00025
Tube No. / Description:	181 - 0.025" Enhanced Copper	230 - 0.025" Enhanced Copper
Design Working Pressure(psig)	150	150
Entering Water Nozzle @ Location:	A	12
Leaving Water Nozzle @ Location:	H	13
Water Box Weight, ea (lbs) (1):	315	565
Cover Plate Weight, ea (lbs):	N/A	350
Return Head Weight (lbs):	N/A	350
Water Weight (lbs):	650	1294

Performance Data	
KW	225
KW/Ton	0.630
NPLV (2)	0.596
Shaft HP	284

Electrical Data	
FLA	713
LRA	5096
Inrush Amps	2205
Oil Pump Volts	208/3/60
Oil Pump FLA	7.2
Min Circuit Amps	908
Max Fuse/Breaker	1600
Type Starter: Solid State Starter	

Other	
Operating Wt. (lbs)	22698
Refrigerant Wt. (lbs)	1400
Oil Charge (gal)	20
Motor Wt. (lbs)	1520
Compressor Wt. (lbs)	3500
Starter Wt. (lbs)	300
Shipping Wt. (evap.)	6220
Shipping Wt. (cond.)	6774
Shipping Wt. (driveline)	5420

Notes:

(1) Not including cover plate on marine boxes.

(2) Chiller IPLV/NPLV value calculated to ARI Standard 550/590-98 equation.

Project Name: Del Castle Chiller	Sold To: STOCKTON MECHANICAL
Location: ,	Cust. Purch. Order No.: Signed Quote
Engineer: VERVERELLI, DIMITRI J.	York Contract No.: 00111034
Contractor:	Date: Revision Date:

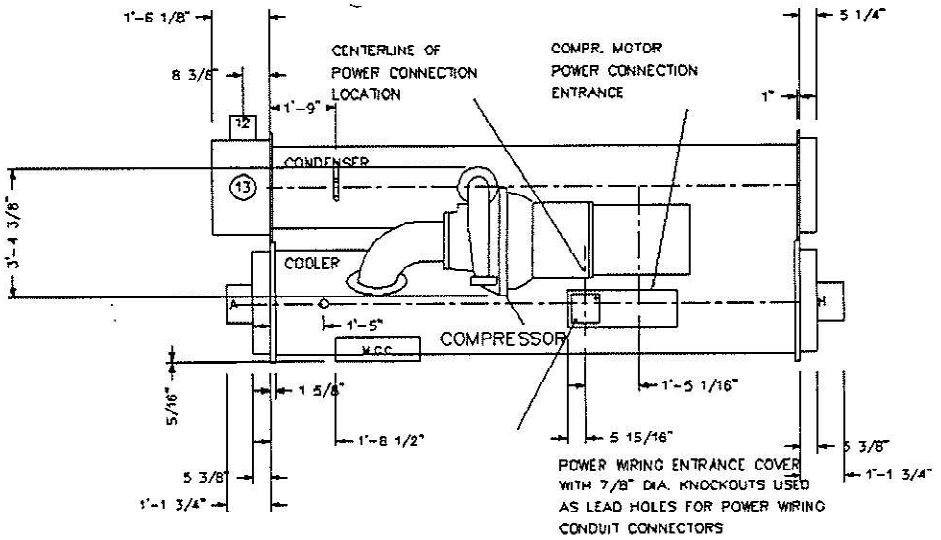
YORK INTERNATIONAL CORPORATION

Philadelphia Applied Systems
75 Great Valley Parkway
Malvern, PA 19355
800-528-YORK

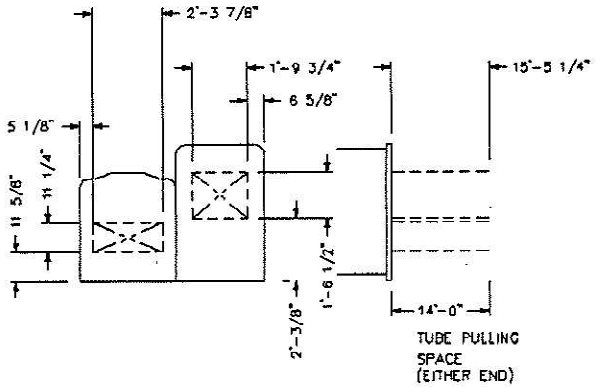
SECTION 1

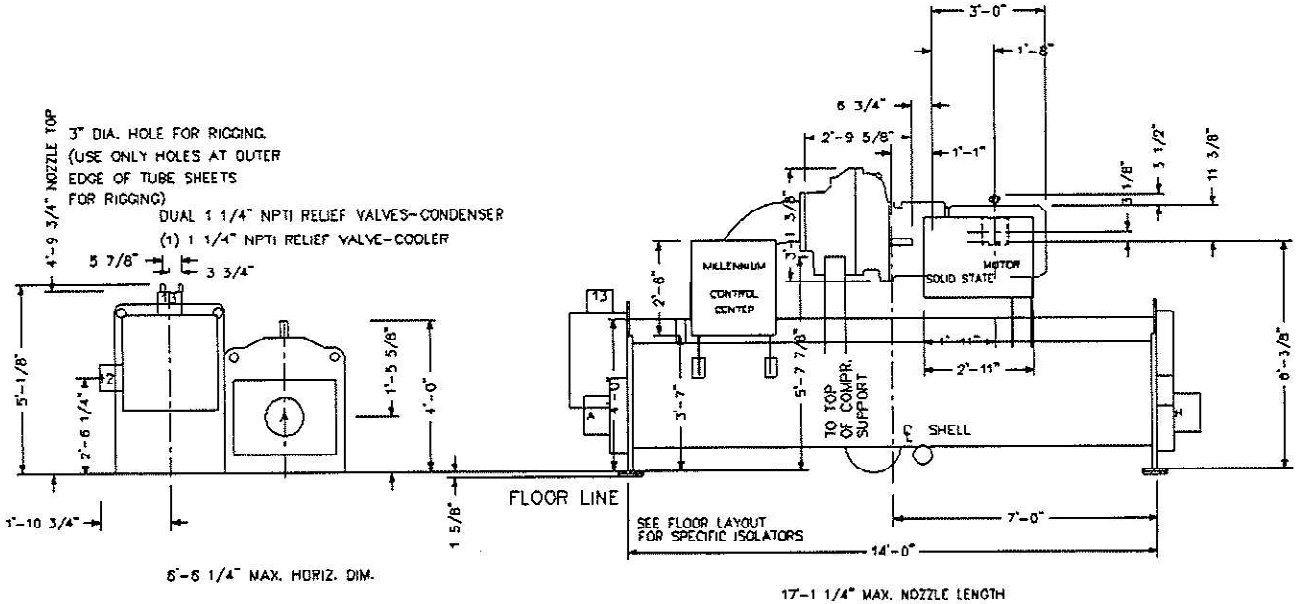
Unit Drawing

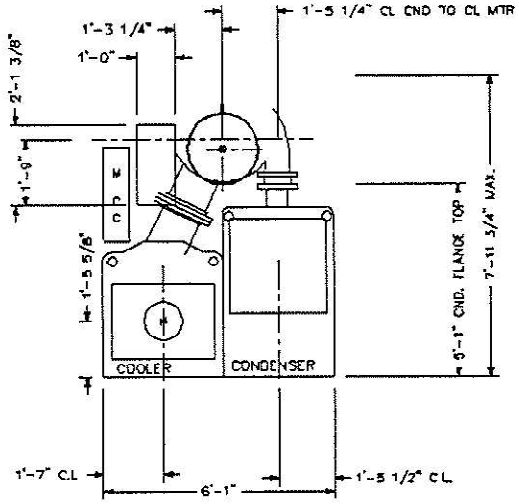
DEL CASTLE CHILLER



– NOZZLE LEGEND –
COOLER IN "A" 1 PASS 12" DIA (150 PSIG DWP)
COOLER OUT "H" 1 PASS 12" DIA (150 PSIG DWP)
CONDENSER IN "12" 2 PASS 8" DIA (150 PSIG DWP)
CONDENSER OUT "13" 2 PASS 8" DIA (150 PSIG DWP)







SHIPPING WT. OF HEAVIEST COMPONENT: 6774 LBS. OPERATING WT. 22698 LBS. LOAD PER ISOLATOR 5674 LBS

PRODUCT DRAWING
ILLENNIUM LIQUID CHILLER
ODEL YK CB DB G4 – CL E
OT FOR CONSTRUCTION

Project Name: Del Castle Chiller
Location: ,
Engineer:
Contractor:
For: REFERENCE

Sold To: STOCKTON MECHANICAL
Cust Purch Order#.: Signed Quote
York Contract#.: 00111034

UNIT TAG: CH – 1

Date:
Rev Date:
Form: 160.49-PA2
Dwg. Lev.: 1/95
Dwg. Scale : NTS

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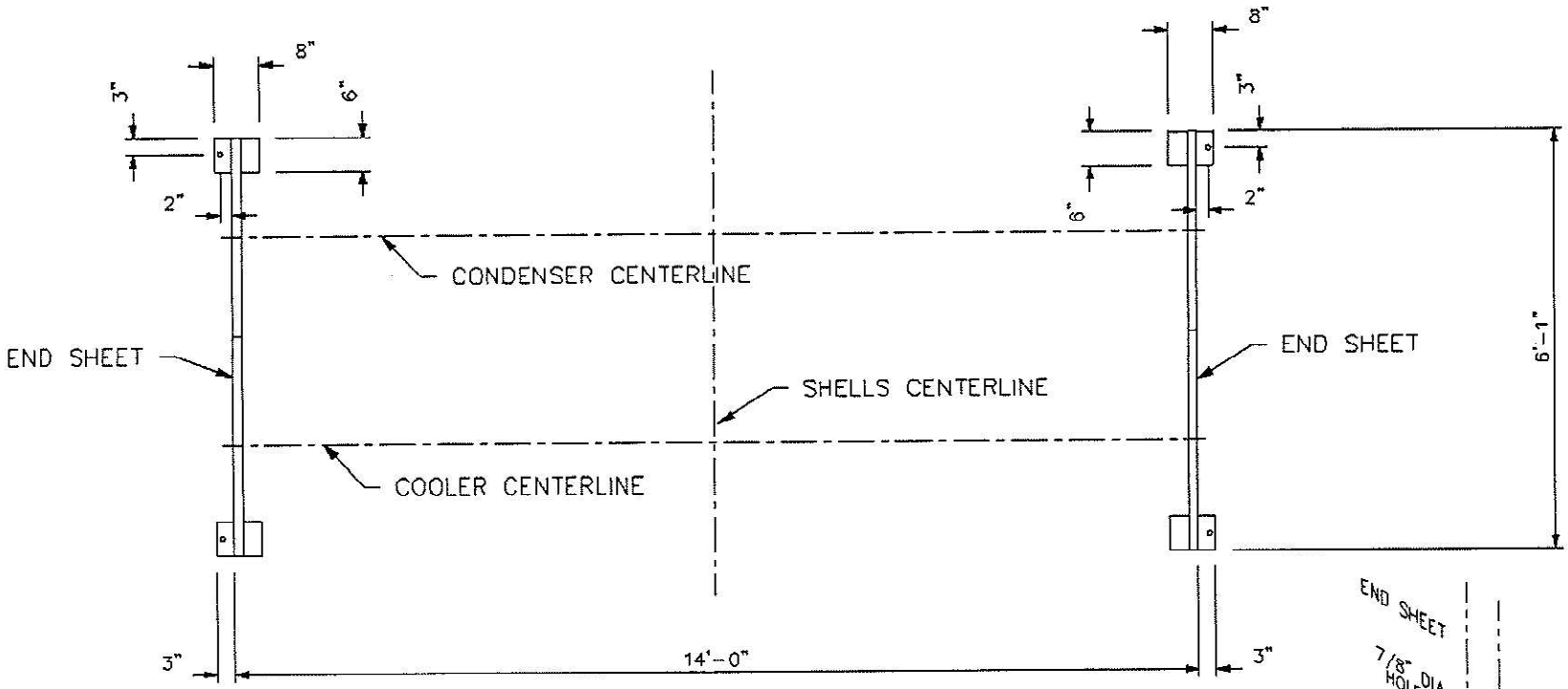
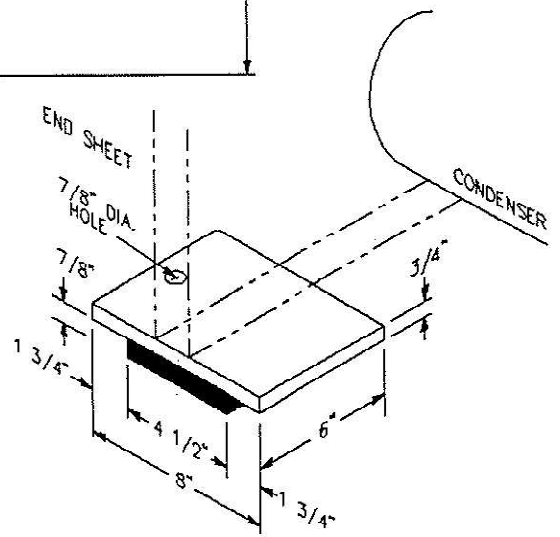
FLOOR LAYOUT





OPERATING WT.: 22698 LBS. LOAD PER ISOLATOR: 5674 LBS

PRODUCT DRAWING FLOOR LAYOUT W/ NEOPRENE ISOLATORS MODEL YK CE[illegible]B G4 – CL E NOT FOR CO[illegible]RUCTION	Project Name: Del Castle Chiller Location: , Engineer: Contractor: For: REFERENCE	Sold To: STOCKTON MECHANICAL Cust Purch Order#.: Signed Quote York Contract#.: 00111034 U[illegible] T[illegible] CH – 1	Date: Rev Date: Form: 160.49–PA2 Dwg. Lev.: 1/95 Dwg. Scale : NTS

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YORK® INTERNATIONAL CORPORATION

Philadelphia Applied Systems
75 Great Valley Parkway
Malvern, PA 19355
800-528-YORK

SECTION 1

Wiring Diagram

Field Connections

OptiView Control Center Wiring w/ Solid State Starter

Field Control Modifications

DEL CASTLE CHILLER

YORK® PRODUCT DRAWING YORK INTERNATIONAL CORPORATION P.O. Box 1592, YORK, PA 17405	New Release — FORM 160.54-PW5.1 (600) **WIRING DIAGRAM – FIELD CONNECTIONS** ***MILLENNIUM*® MODEL YK CHILLERS (STYLE E)** **WITH STYLE B SOLID STATE STARTER**
CONTRACTOR STOCKTON MECHANICAL ORDER NO. _____ YORK CONTRACT NO. 00111034 YORK ORDER NO. 1	PURCHASER _____ JOB NAME Del castle chiller LOCATION _____ ENGINEER Dino Verbarelli
☐ REFERENCE DATE _____	☐ APPROVAL DATE _____
☐ CONSTRUCTION DATE _____	

JOB DATA:

CHILLER MODEL NO. YK CBDBG4-CLE NO. OF UNITS 1

STYLE B SOLID STATE STARTER, MODEL NO. SSS– _____ K L _____ B

MOTOR/STARTER POWER _____ VOLTS, 3-PHASE _____ HZ

OPTIONAL FACTORY INSTALLED DISCONNECT SWITCH _____ AMPS **or**

~~OPTIONAL~~ FACTORY INSTALLED CIRCUIT BREAKER WITH GROUND FAULT PROTECTION _____ AMPS

NOTES:

1. All field wiring shall be in accordance with the current edition of the National Electrical Code (N.E.C.) as well as all other applicable codes and specifications.
2. Solid State Starter shall be grounded in accordance with the 1999 N.E.C. (Paragraph 250-118) for equipment grounding. Flexible conduit is required for final connection to the starter. When a separate grounding conductor is required, it must be a copper conductor only and sized per the 1999 N.E.C. (Table 250-122). Per 1999 N.E.C. [Paragraph 250-120 (f)(1)], where multiple (parallel) conduits are used each must contain a grounding conductor. See Note 8 for grounding lug wire range.
3. Wiring, electrical conduit, junction boxes, fused disconnect switches (FDS), or circuit breakers, starters (M), push-button stations (PB), manual-off-automatic switch (S), flow switch (FLS), and control relays furnished by others unless otherwise specified.
4. Items marked * furnished by York International Corporation.
5. Items marked ** available from York International Corporation at additional cost.
6. Control Center power supply 115V-50/60 Hz, 2.0KVA capacity for control center only, is supplied by a control power transformer (1T) mounted on the side of the Solid State Starter as shown. It is factory wired.
7. Starter power conduit connection (cut holes to suit) locations, motor full load amperes (FLA), locked rotor amperes and inrush amperes per Product Drawing Form 160.54-PA1. Flexible conduit must be used for final connections to starter. Multiple conduits shall contain an equal number of wires from each phase in each conduit to prevent overheating per 1999 N.E.C. (Paragraph 300-20 (a)). Use copper conductors only; DO NOT USE aluminum conductors. See Note 8 for factory furnished starter terminal lug wire ranges and conduit connection provisions.

8. The following terminal lugs are factory furnished for field wiring connections when a factory-installed disconnect switch or circuit breaker is not supplied. All lugs are rated AL9CU.

Starter Model No. w/o Disconnect/ Circuit Breaker Option	Line Side Lugs		Grounding Lug, Wire Range, Quantity AL9CU
	Quan. Per Terminal	Wire Range	
SSS 7LK	1	#4-600 kcmil	#14-1/0, one bbl.
SSS 14LK	2	#2-600 kcmil	#14-1/0, two bbl.
SSS 26LK	3	#2-600 kcmil	#4-600 kcmil, two bbl. or 1/0 - 250 kcmil, four bbl.
SSS 33LK	4	#2-600 kcmil	

The following terminal lugs are factory furnished for field wiring connections when a factory-installed disconnect switch or circuit breaker with ground fault protection is supplied:

Starter Model No. & Available Disconnect Switch/ Circuit Breaker Amp Rating (See Note 15 (a))	Line Side Lugs			Grounding Lug, Wire Range, Quantity AL9CU
	Quan. Per Terminal	Wire Range	Lug Rating	
SSS 7LK, 250A	1	#6-350 kcmil	AL7CU	#14-1/0, one bbl.
SSS 7LK, 400A	2	3/0-250 kcmil	AL7CU	
SSS 14LK, 400A	2	3/0-250 kcmil	AL7CU	#14-1/0, two bbl.
SSS 14LK, 600A	2	250-500 kcmil	AL9CU	
SSS 26LK, 1200A/1000A	4	4/0-500 kcmil	AL9CU	#4-600 kcmil two bbl. or 1/0-250 kcmil, four bbl.
SSS 33LK, 1200A	4	4/0-500 kcmil	AL9CU	

9. Condenser water pump motor starter (3M) holding coil to be furnished for 115V-50/60 Hz. The power requirements for the water pump starter (3M) must be a max. of 1 Amp holding and 10 Amps inrush. If power requirements exceed this value, furnish coil for line voltage, and control relay with 115V coil.

10. Units shipped knocked down require field connection of harnesses to control panel, power wiring between compressor motor and starter, and oil pump starter to solid state starter. These harnesses and power wiring are furnished by York International Corporation for field assembly and consist of proper lengths of flexible conduit with necessary connectors, and contain the wires (shown in Note 13) properly terminated and marked.

11. Wire #14 AWG copper for one way distance of less than 175 feet. Wire #12 AWG copper for one way distance of more than 175 feet, but less than 300 feet.

12. Wiring diagram for YORK OptiView Control Center Form 160.54-PW2. Field wiring modifications per Form 160.54-PW7. Wiring diagram for YORK Style B Solid State Starter Form 160.00-PW4.

13. The following interconnecting wires are factory supplied when a YORK Style B Solid State Starter is used. (See Form 160.54-PW2.1.)

    a. Starter to control center – L, 2, 16, 24, 53, 3-conductor shielded cable, 2-conductor shielded cable.

    b. Starter to oil pump motor starter – 101, 102, 103.

    c. Starter to cooling pump – 2, 108, GRD.

14. Oil pump motor for compressor is 2HP. Full load amperes for oil pump drive panel (furnished by York International Corporation with starter factory wired) and 2.0 KVA control power transformer (furnished by York International Corporation and factory wired) to be used with Notes 15, 16 and 18 are:

3 PHASE VOLTAGE	Hz	OIL PUMP DRIVE PANEL (AMPS) 2HP	CONTROL POWER (1T) TRANSFORMER (AMPS)
200/208	60	7.2	10.0
220/230/240	60	7.2	9.1
440/460/480	60	3.6	4.5
550/575/600	60	2.9	3.6
380/400/415	50/60	4.3	5.3

15. If an optional circuit breaker is not provided, the branch circuit overcurrent protection device(s) for the YORK Solid State Starter must be a time delay type with a rating which is sized in accordance with the NEC, and shall not exceed the smaller of the two ratings listed below, (a) or (b):

    a. The next standard fuse/breaker rating below:

    2.25 (Compressor Motor FLA) + Oil Pump Motor Amps + Control Transformer Amps

    b. A rating limited by the starter size as follows:

STARTER MODEL NO.	MAX. FUSE/BREAKER SIZE (AMPS)
SSS 7L	500
SSS 14L	1000
SSS 26L	1600
SSS 33L	2000

Where 2.25 factor is per 1999 N.E.C. (Para. 440-22 (a) and (b); FLA is per Note 7; oil pump motor and control power transformer Amps per Note 14.

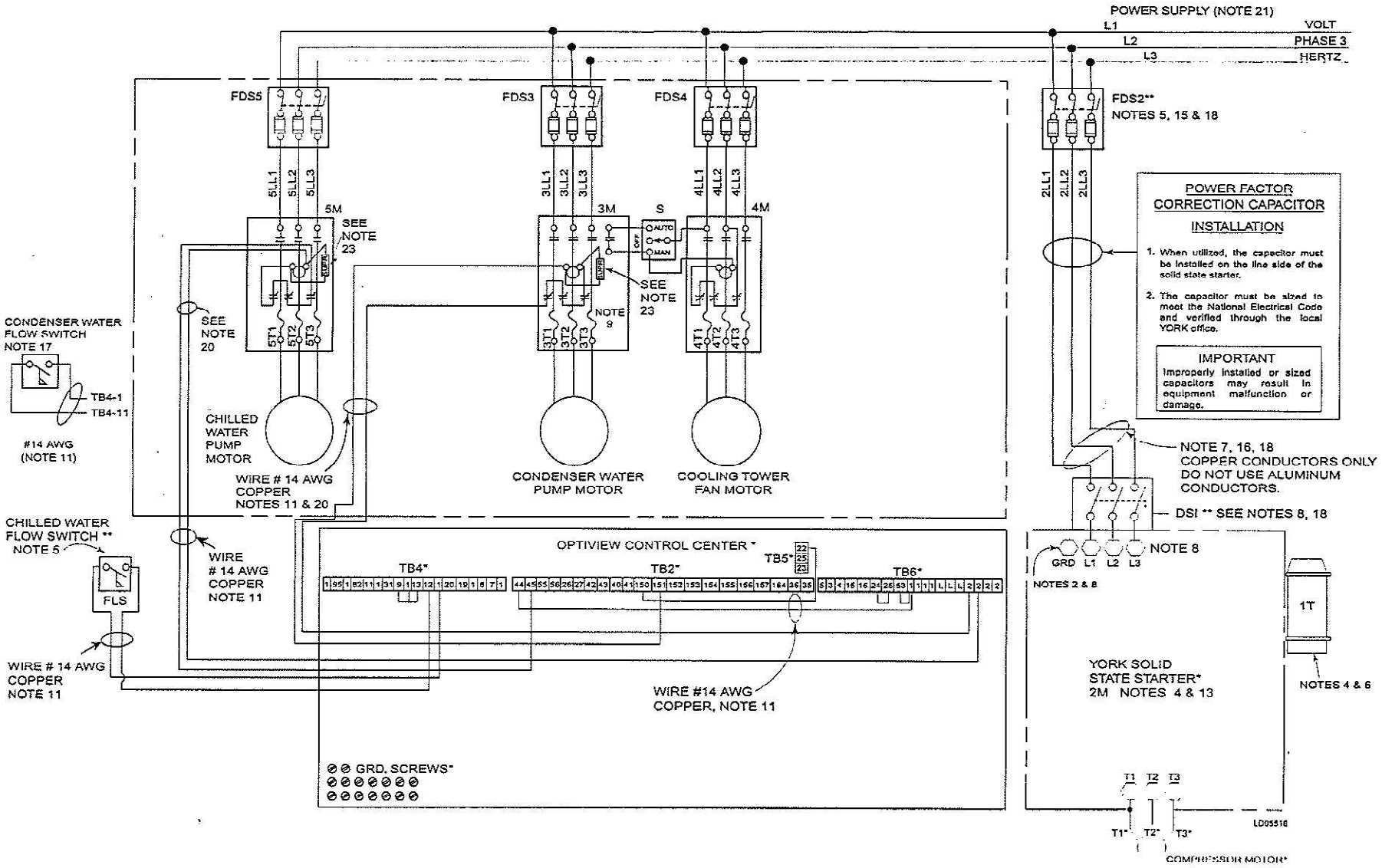
16. The YORK Style B Solid State Starter power wiring ampacity shall be calculated as follows.

Model YK minimum circuit ampacity:

Ampacity = 1.25 (Compressor Motor FLA) + Oil Pump Motor Amps + Control Transformer Amps, where 125% factor is per 1999 N.E.C. (Para. 440-33); FLA is per Note 7; Oil Pump and Control Transformer Amps per Note 14

FORM 160.54-PW5.1

WIRING DIAGRAM FIELD CONNECTIONS
(STYLE "B" SOLID STATE STARTER)



YORK INTERNATIONAL

17. The Condenser Flow Switch is optional. If not present, a jumper must be installed between TB4-11 and TB4-1.

18. The short-circuit withstand capacity, as described in UL Standard 508, in symmetrical RMS current is listed in the following table for each of the field wiring option kits:

MODEL	OPTION KIT	KA RATING (SYMMETRICAL A, RMS) 480V MAX	600V MAX
SSS7L	LUG	18	18
	250 A DISCONNECT SW.	18	18
	400 A DISCONNECT SW.	18	18
	250 A CIRCUIT BREAKER	65	22
	400 A CIRCUIT BREAKER	65	22
SSS14L	LUG	30	30
	250 A DISCONNECT SW.	30	22
	400 A DISCONNECT SW.	30	22
	600 A DISCONNECT SW.	30	30
	250 A CIRCUIT BREAKER	65	22
	400 A CIRCUIT BREAKER	65	22
	600 A CIRCUIT BREAKER	65	35
SSS26L	LUG	42	42
	1200 A DISCONNECT SW.	42	42
	1000 A CIRCUIT BREAKER	65	50
SSS33L	LUG	42	42
	1200 A CIRCUIT BREAKER	65	50

19. If the fused disconnect switch (FDS2) is not located in sight (1999 N.E.C. Para. 440-14) of the YORK Style B Solid State Starter, a non-fused disconnect switch (not shown) shall be located in sight of the Solid State Starter; between FDS2 and Solid State Starter. The ampere rating shall be determined as follows for the disconnect switch of FDS2: The larger of

    a. Amp Rating = 1.15 (Compressor Motor FLA+ Oil Pump Drive Panel Amps + Control Transformer Amps)

    – or –

    b. The size required to mount the fuses determined in Note 15 (if a fused disconnect is employed).

    Where 115% factor is per 1999 N.E.C. (Para. 440-12b (2)); FLA is per Note 7; oil pump drive panel and control power transformer Amps per Note 14. An optional factory mounted and wired disconnect switch within the Style B SSS is available (See Note 8).

20. Control circuit wiring for 3M condenser water pump motor starter is shown for cooling only application.

    For units with Flash Miniature Card Software Version C.MLM.01.00 through C.MLM.01.03, the condenser water pump should be wired to terminal 164 of TB2 instead of terminal 151, and the wire from terminal 22 of TB5 to terminal 150 of TB2 shall not be installed. For software version C.MLM.01.04 and higher, the condenser water pump connection should be as shown in the figure.

21. The main power transformer should be adequately sized such that the transformer voltage drop does not exceed 10% during unit start-up. The supply voltage, at starter input terminals, during start-up must be maintained above the minimum value specified in the table. Note that while the YORK chiller will perform acceptably during startup with this amount of voltage drop, the performance of other equipment connected to the supply transformer could be adversely affected.

THREE PHASE VOLTAGE	Hz	MINIMUM VOLTAGE AT STARTER INPUT TERMINALS DURING START-UP
200/208	60	160
220/230/240	60	185
440/460/480	60	370
550/575/600	60	460
380	50/60	305
400	50	320
415	50	335

22. Automatic control of the chilled water pump by the OptiView Control Center is shown. Chilled water pump motor starter (5M) holding coil to be furnished for 115V-50/60 Hz. The power requirements for the water pump starter (5M) must be a maximum of 1 Amp holding and 8 Amps inrush. If power requirements exceed this value, furnish coil for line voltage, and control relay with 115V coil.

    The pumps operate during oil pump prerun, during compressor operation & during cycling shutdown.

23. Each 115VAC field-connected inductive load, i.e. relay coil, motor starter coil, etc. shall have a transient suppressor wired (by others) in parallel with its coil, physically located at the coil. Spare transient suppressors are factory supplied in a bag attached to the keypad cable clamp in the Control
24. Center.

STARTER MODEL NO.	NO. OF CONDUITS MAX. TRADE CONDUIT SIZE
7LK, 14LK	(2) 3"
26LK, 33LK	(4) 3"

YORK® PRODUCT DRAWING YORK INTERNATIONAL CORPORATION P.O. Box 1592, York, PA 17405	New Release — Form 160.54-PW2.1 (300) **WIRING DIAGRAM, *MILLENNIUM*® MODEL YK (STYLE E) LIQUID CHILLERS OPTIVIEW CONTROL CENTER WITH STYLE B SOLID STATE STARTER**
CONTRACTOR STOCKTON MECHANICAL ORDER NO. _____ YORK CONTRACT NO. 00-111,034 YORK ORDER NO. 01	PURCHASER _____ JOB NAME DEL CASTLE CHILLER LOCATION _____ ENGINEER DIMITRI VERVERELLI
☐ REFERENCE DATE _____	☐ APPROVAL DATE _____ ☐ CONSTRUCTION DATE _____

JOB DATA:

CHILLER MODEL NO. YK CBDBG4-CLE

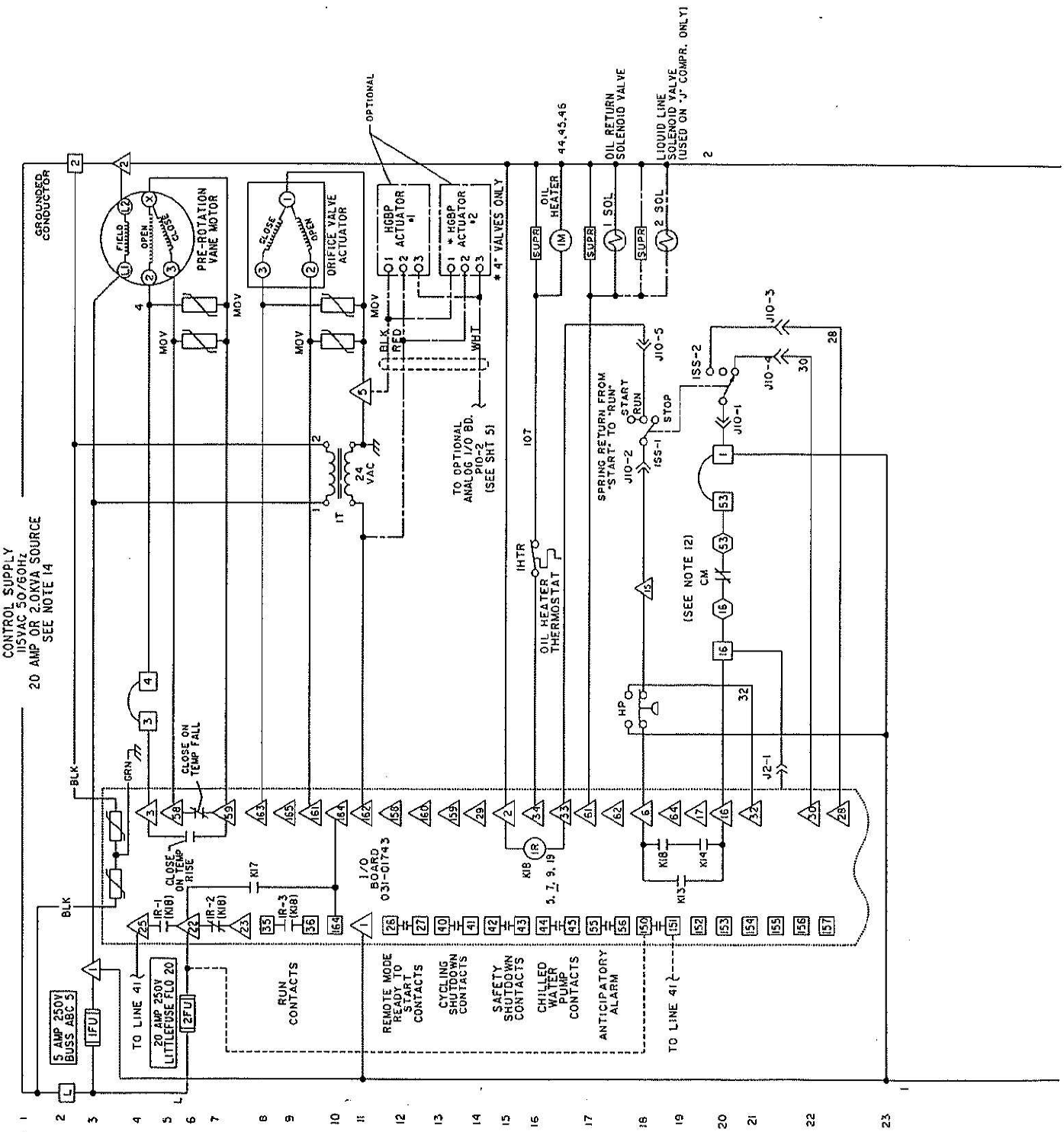
NO. OF UNITS _____

COMPRESSOR MOTOR _____ VOLTS, 3-PHASE, _____ Hz

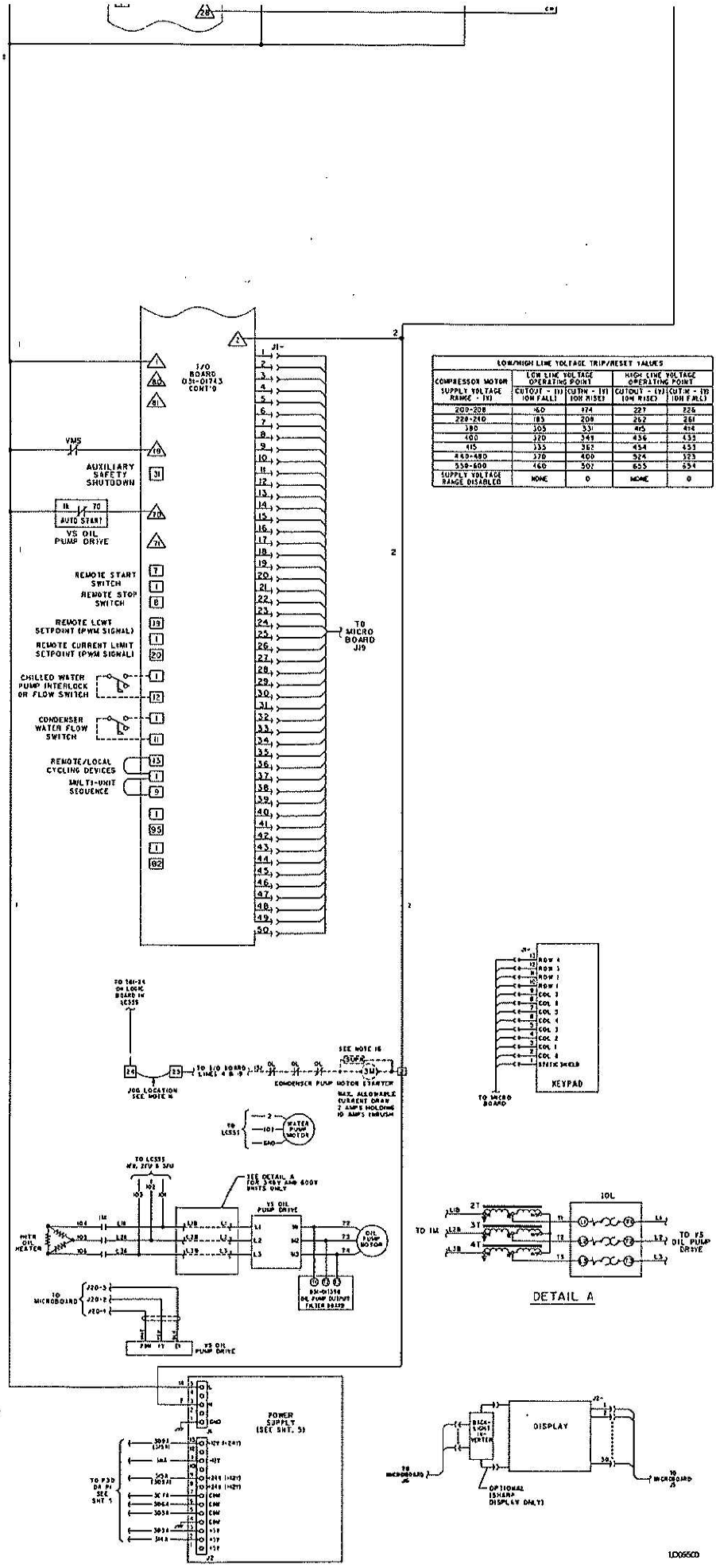
OIL PUMP MOTOR _____ VOLTS, 3-PHASE, _____ Hz, _____ FLA

REMARKS:

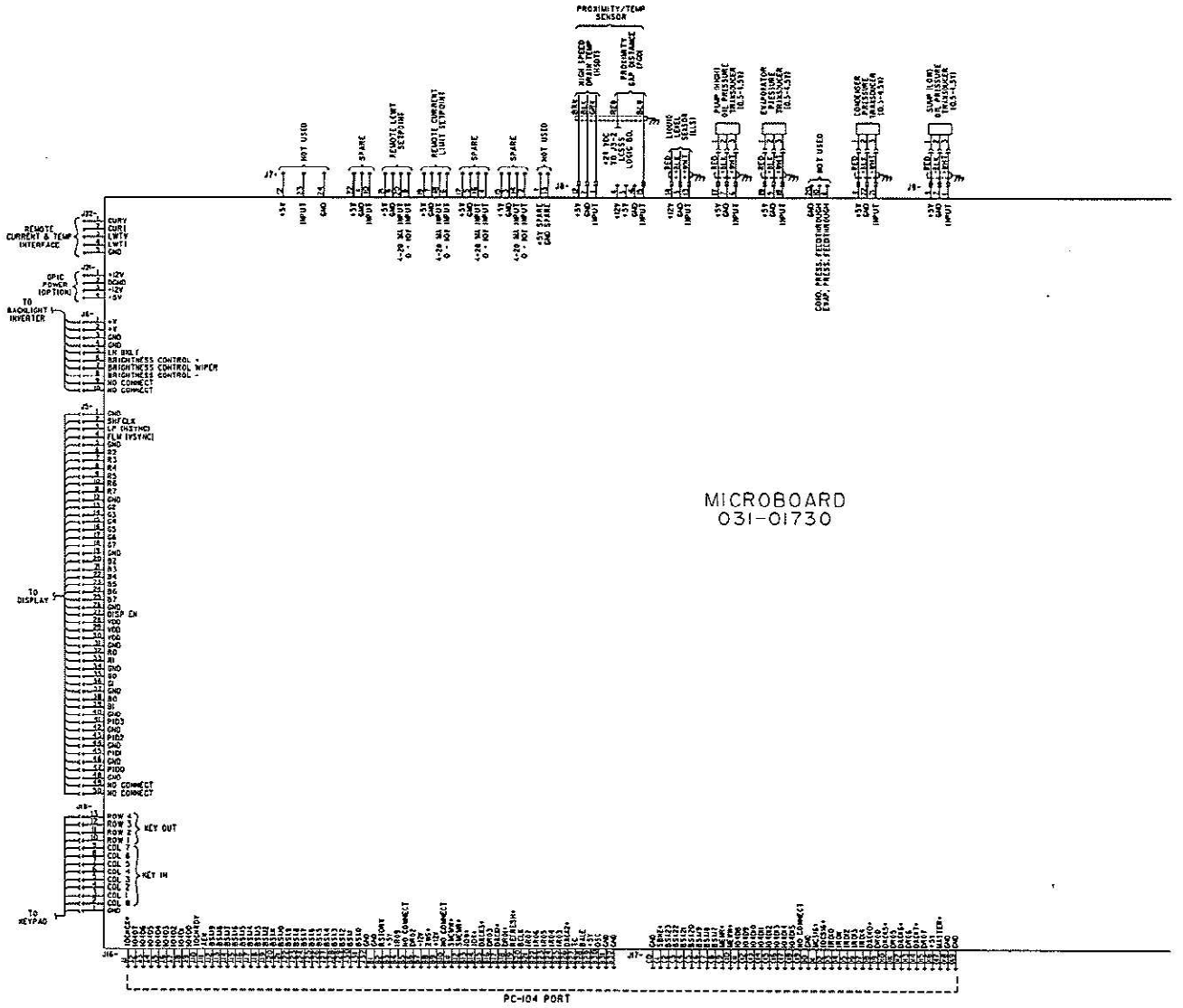
ELEMENTARY DIAGRAM

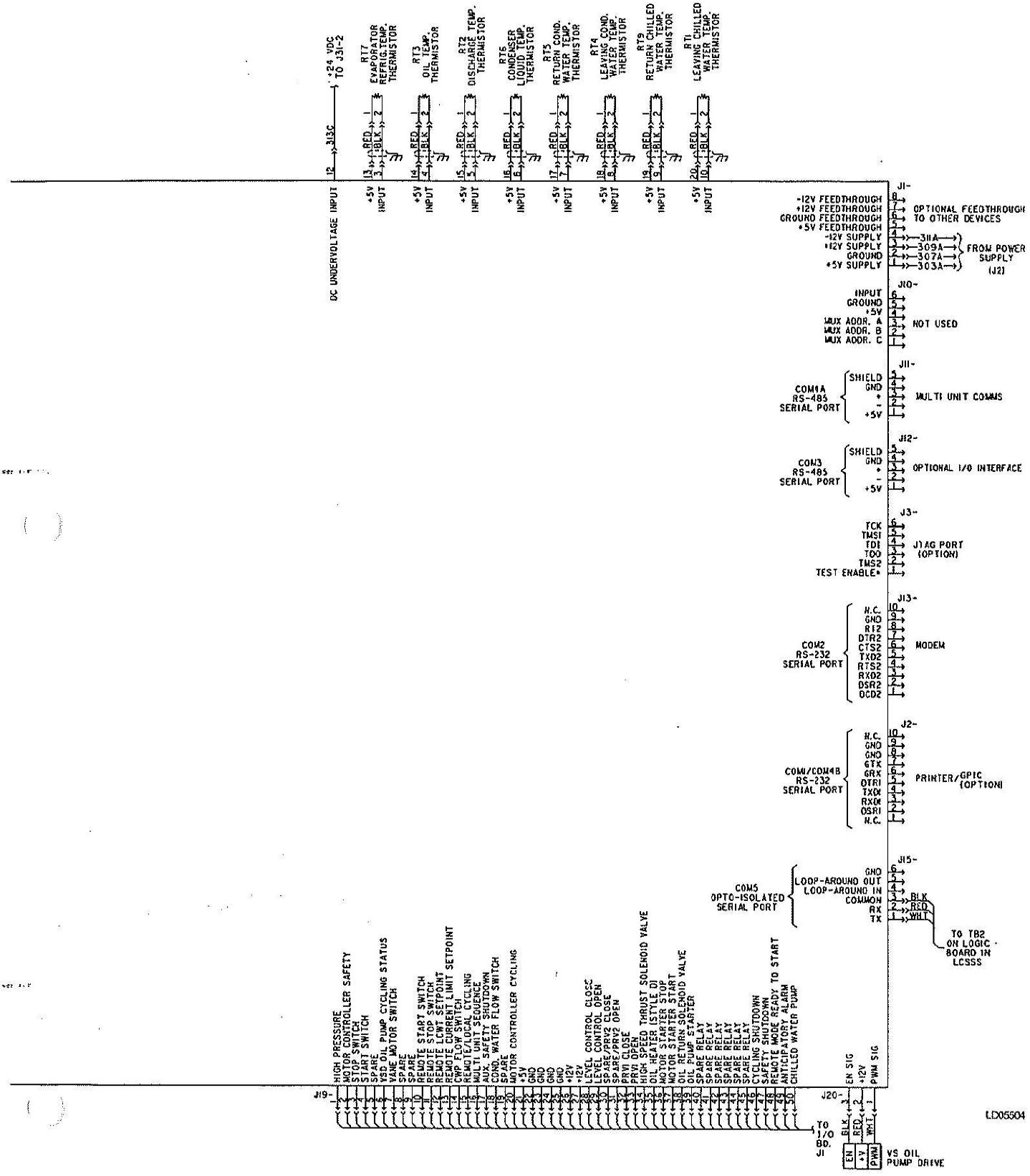


DWG. 035-17157 (REV. –)

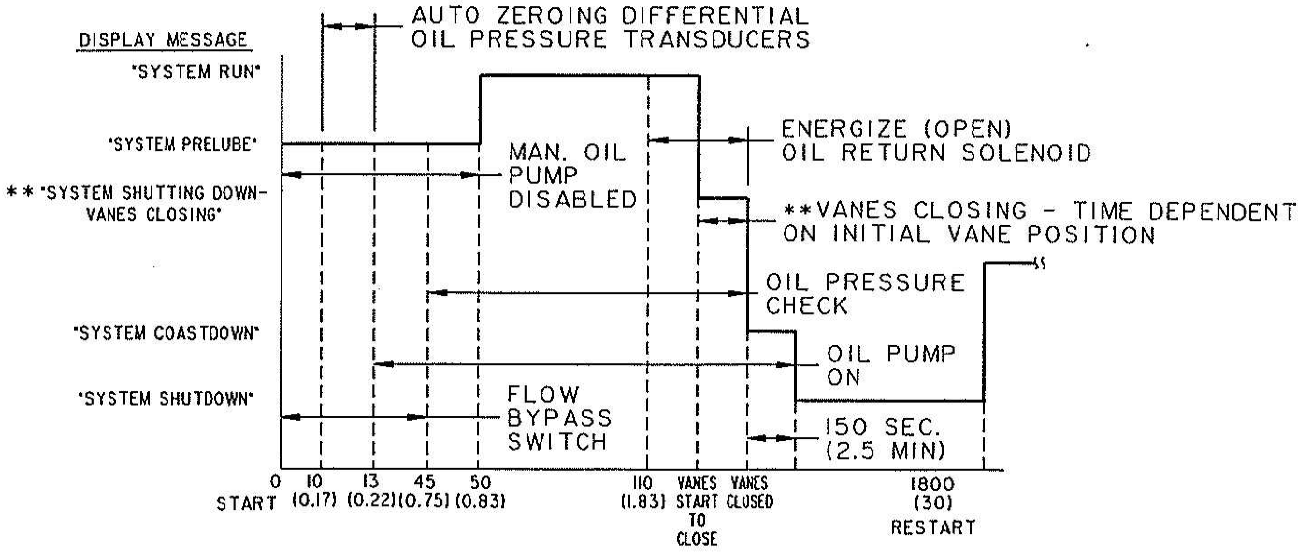

I/O BOARD 031-01743 CONT'D
J1
TO MICRO BOARD J19
VMS
AUXILIARY SAFETY SHUTDOWN
AUTO START
VS OIL PUMP DRIVE
REMOTE START SWITCH
REMOTE STOP SWITCH
REMOTE LCWT SETPOINT (PWM SIGNAL)
REMOTE CURRENT LIMIT SETPOINT (PWM SIGNAL)
CHILLED WATER PUMP INTERLOCK OR FLOW SWITCH
CONDENSER WATER FLOW SWITCH
REMOTE/LOCAL CYCLING DEVICES
MULTI-UNIT SEQUENCE
LOW/HIGH LINE VOLTAGE TRIP/RESET VALUES
COMPRESSOR MOTOR SUPPLY VOLTAGE RANGE - (V)
LOW LINE VOLTAGE OPERATING POINT
HIGH LINE VOLTAGE OPERATING POINT
CUTOUT - (V) (ON FALL)
CUTIN - (V) (ON RISE)
200-208 160 174 227 225
220-240 185 208 262 261
380 305 331 415 414
400 320 349 436 433
415 335 362 454 453
440-480 370 400 524 523
550-600 460 507 655 654
SUPPLY VOLTAGE RANGE DISABLED NONE 0 NONE 0
TO 1M OIL HEATER
TO LC555
WATER PUMP CONTACTOR
CONDENSER PUMP MOTOR STARTER
SEE NOTE 16
JOG LOCATION SEE NOTE 16
MAX. ALLOWABLE CURRENT DRAW 2 AMPS HOLDING 10 AMPS INRUSH
KEYPAD
TO MICRO BOARD
10L
TO 1M
TO VS OIL PUMP DRIVE
DETAIL A
TO MICROBOARD
VS OIL PUMP DRIVE
POWER SUPPLY (SEE SHT. 5)
TO P30 OR P1 SEE SHT. 1
DISPLAY
OPTIONAL ISHERN DISPLAY ONLY)
LD06500

ELEMENTARY DIAGRAM (Cont'd)




+24 VDC TO J31-2
RT7 EVAPORATOR REFRIG.TEMP. THERMISTOR
RT3 OIL TEMP. THERMISTOR
RT2 DISCHARGE TEMP. THERMISTOR
RT6 CONDENSER LIQUID TEMP. THERMISTOR
RT5 RETURN COND. WATER TEMP. THERMISTOR
RT4 LEAVING COND. WATER TEMP. THERMISTOR
RT9 RETURN CHILLED WATER TEMP. THERMISTOR
RT1 LEAVING CHILLED WATER TEMP. THERMISTOR
DC UNDERVOLTAGE INPUT
J1
OPTIONAL FEEDTHROUGH TO OTHER DEVICES
FROM POWER SUPPLY (J2)
J10
NOT USED
J11
MULTI UNIT COMMS
COM1A RS-485 SERIAL PORT
J12
OPTIONAL I/O INTERFACE
COM3 RS-485 SERIAL PORT
J3
JTAG PORT (OPTION)
J13
MODEM
COM2 RS-232 SERIAL PORT
J2
PRINTER/GPIC (OPTION)
COM1/COM4B RS-232 SERIAL PORT
J15
COM5 OPTO-ISOLATED SERIAL PORT
TO TB2 ON LOGIC BOARD IN LCSSS
J19
J20
TO I/O BD. J1
VS OIL PUMP DRIVE
LD05504

TIMING DIAGRAM



** This function is not for all shutdowns. See Operations Manual, Form 160.54-O1.

NOTES:

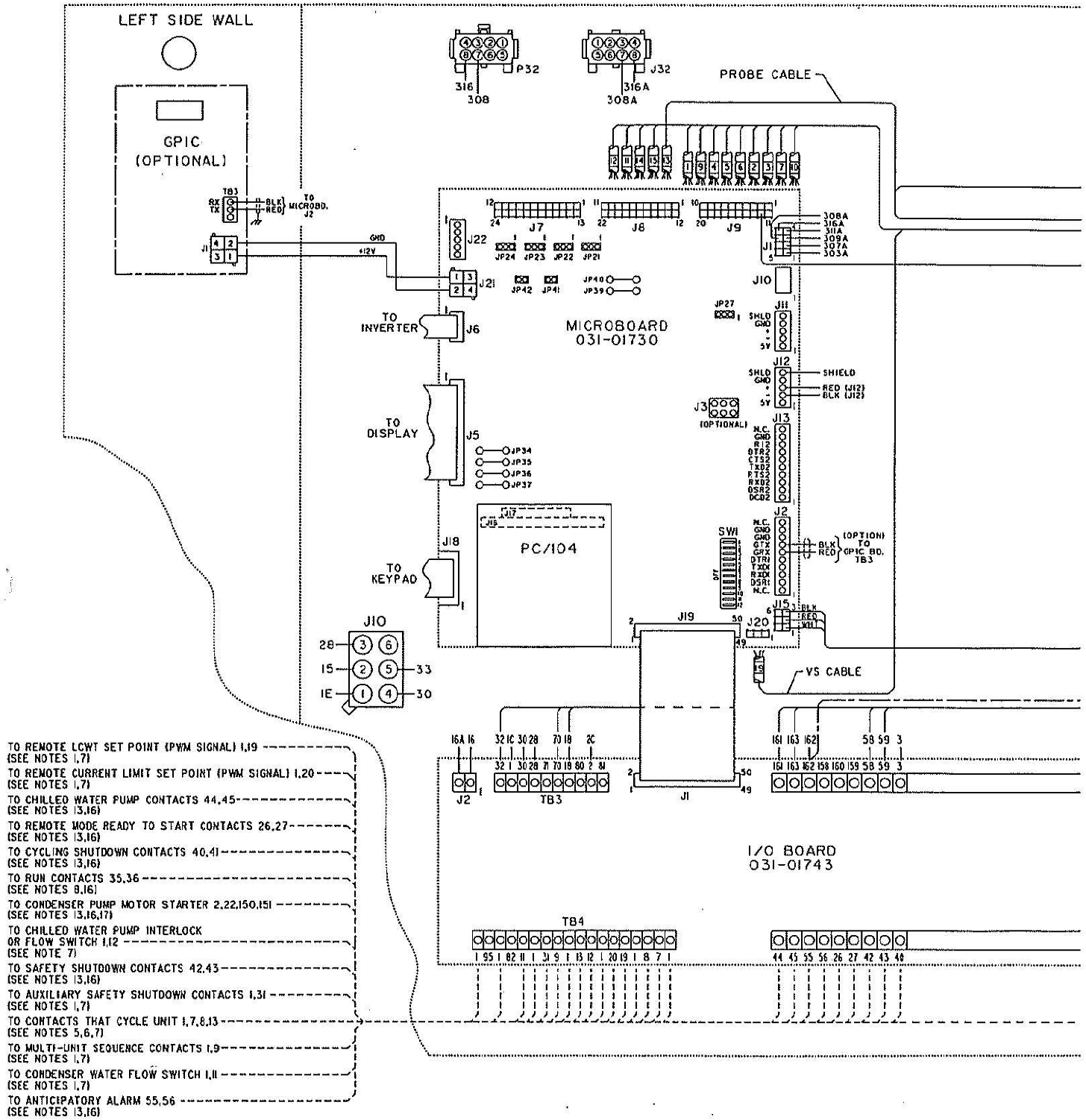
1. This wiring diagram describes the standard electronic control scheme for use with a YORK Solid State Starter. For details of standard modifications, refer to Product Form 160.54-PW7.
2. Field wiring to be in accordance with the National Electrical Code as well as all other applicable codes and specifications. See Product Form 160.54-PW5.1 for field wiring connections.
3. Numbers along the left side of diagram are line identification numbers. The numbers along the right side indicate the line number location of relay contacts. An underlined contact location signifies a normally closed contact.
4. Main control panel Class 1 field wiring terminal connection points are indicated by numbers within a rectangle, i.e. [15] . Main control panel factory wiring terminal connection points are indicated by numbers within a triangle, i.e. △5 . Component terminal markings are indicated by numbers within a circle, i.e. (C1) . Numbers adjacent to circuit lines are the circuit identification numbers.
5. To cycle unit on and off automatically with contacts other than those shown, install a cycling device between terminals [1] & [13] (line 37) (see note 7). If a cycling device is installed, jumper must be removed between terminals [1] & [13] .
6. To stop unit and not permit it to start again, install a stop device between terminals [1] & [8] (Line 33) (see note 7). A remote start-stop switch may be connected to terminals [1] , [7] & [8] (Lines 32 & 33) (see note 7). Remote start-stop switch (Line 32) is operative only in the "remote" operating mode.
7. Device contact rating to be 5 milliamperes @ 115 volts A.C.
8. Contact rating is 5A resistive @ 120 volts A.C. or 240 volts A.C.
9. _____
10. For wiring diagram of Solid State Starter, refer to Product Form 160.04-PW1.
11. To check motor rotation on initial start-up, install momentary switch between terminals [24] & [25] (line 41). Depress start switch. After approx. 30 seconds, jog motor with momentary switch. When proper rotation is obtained, replace momentary switch with jumper. Switch must have a minimum contact rating of 2 FLA., 10 LRA at 115 Volts A.C.
12. Solid State Starter motor overload contact (CM) on Solid State Starter Logic Board is set to trip at 105% FLA.
13. Contact rating is 5 Amps resistive @ 250 Volts A.C. & 30 Volts D.C., 2 Amp inductive (.4 PF) @ 250 Volts A.C. & 30 Volts D.C.
14. Field connected control power supply is not required, as control transformer is supplied on the Solid State Starter.
15. _____
16. Each 115VAC field-connected inductive load: i.e. relay coil, motor starter coil, etc., shall have a transient suppressor wired in parallel with its coil, physically located at the coil. Spare transient suppressors and control circuit fuses are supplied in a bag attached to green ground screw in lower left corner of control panel.
17. For units with Flash Miniature Software Card Version C.MLM.01.00 through C.MLM.01.03, the condenser water pump should be wired to terminal 164 of TB2 instead of terminal 151, and the wire from terminal 22 of TB5 to terminal 150 of TB2 shall not be installed. For software version C.MLM.01.04 and higher, the condenser pump connection should be as shown in the figure.

LEGEND

IHTR	3 PHASE THERMOSTATICALLY CONTROLLED 3000 WATT OIL HEATER AT LINE VOLTAGE
IM	3 PHASE OIL HEATER CONTACTOR
3M	CONDENSER PUMP MOTOR STARTER
IR	COMPRESSOR MOTOR/ IHTR HEATER CONTROL RELAY (KI8 - LOCATED ON I/O BD.)
3R	VS OIL PUMP DRIVE RUN RELAY
ISOL	OIL RETURN SOLENOID VALVE
2SOL	LIQUID LINE SOLENOID VALVE (USED ON "J" COMPR. ONLY)
ISS	DPDT 3 POSITION ROCKER SWITCH
ITB	TERMINAL BLOCK, FACTORY WIRING (IN SOLID STATE STARTER)
2T,3T,4T	BUCK/BOOST TRANSFORMERS (346V AND 600V UNITS ONLY)
CM	SOLID STATE OVERLOAD/POWER FAULT CONTACTS (PART OF LCSSS LOGIC BOARD)
FDTS	FAULTY DISCHARGE TEMP. SENSOR
FLA	FULL LOAD AMPS (COMPRESSOR MOTOR)
FU	FUSE
HSDT	HIGH SPEED DRAIN TEMP. (PROBE LOCATED IN COMPRESSOR)
PGD	PROXIMITY GAP DISTANCE
HDT	REFRIG. HIGH DISCHARGE TEMP. (PROVIDED BY RT2)
HOP	HIGH OIL PRESSURE (PROVIDED BY TWO TRANSDUCERS)
HOT	HIGH OIL TEMPERATURE (PROVIDED BY RT3)
HP	HIGH PRESSURE CUTOUT
LEP	LOW EVAPORATOR PRESSURE (PROVIDED BY EVAP. PRESS TRANSDUCER)
LLS	LIQUID LEVEL SENSOR (PROBE)
LOT	LOW OIL TEMPERATURE (PROVIDED BY RT3)
LOTD	LOW OIL TEMP. DIFFERENTIAL (PROVIDED BY RT3 AND CONDENSER PRESS. TRANSDUCER)
HGBP	HOT GAS BYPASS
IT	CLASS 2 POWER SUPPLY TRANSFORMER
LWT	LOW WATER TEMPERATURE (PROVIDED BY RTI)
MOV	METAL OXIDE VARISTOR
OL	MOTOR STARTER OVERLOADS
IOL	2T PROTECTOR (346V AND 600V UNITS ONLY)
OP	LOW OIL PRESSURE (PROVIDED BY TWO TRANSDUCERS)
OVA	ORIFICE VALVE ACTUATOR
PRV	PRE-ROTATION VANE MOTOR
RTI-RT9	RESISTANCE TEMPERATURE SENSING ELEMENT
RES	RESISTOR
SUPR	TRANSIENT SUPPRESSOR
TBI,TB3,TB5,	TERMINAL BLOCK, FACTORY WIRING – △
TB2,TB4	TERMINAL BLOCK, FIELD CONNECTION – □
TB6	TERMINAL BLOCK, FIELD (BOTTOM), FACTORY (TOP)
VMP	VANE MOTOR POTENTIOMETER
VMS	VANE MOTOR SWITCH
VS	VARIABLE SPEED OIL PUMP DRIVE
-------	FIELD WIRING
———	FACTORY WIRING
.....	CIRCUIT BOARD OR ENCLOSURE BOUNDARY
—→	JACK (JI,J2,...)
>—	PLUG (PI,P2,...)
◎	WIRE ENTRANCE HOLE IN CONTROL PANEL
—— ——	OPTION (WHEN SUPPLIED) BY YORK.
—·—·—	MECHANICAL LINKAGE
⊂----⊢	SHIELDED CABLE
⊣◪⊢	METAL OXIDE VARISTOR
KI3,KI4,KI7	RELAYS MOUNTED ON I/O BOARD - SEE OPERATOR'S MANUAL
⬡	TERMINAL LOCATED IN LCSSS (TBI)

LD05503

CONNECTION DIAGRAM



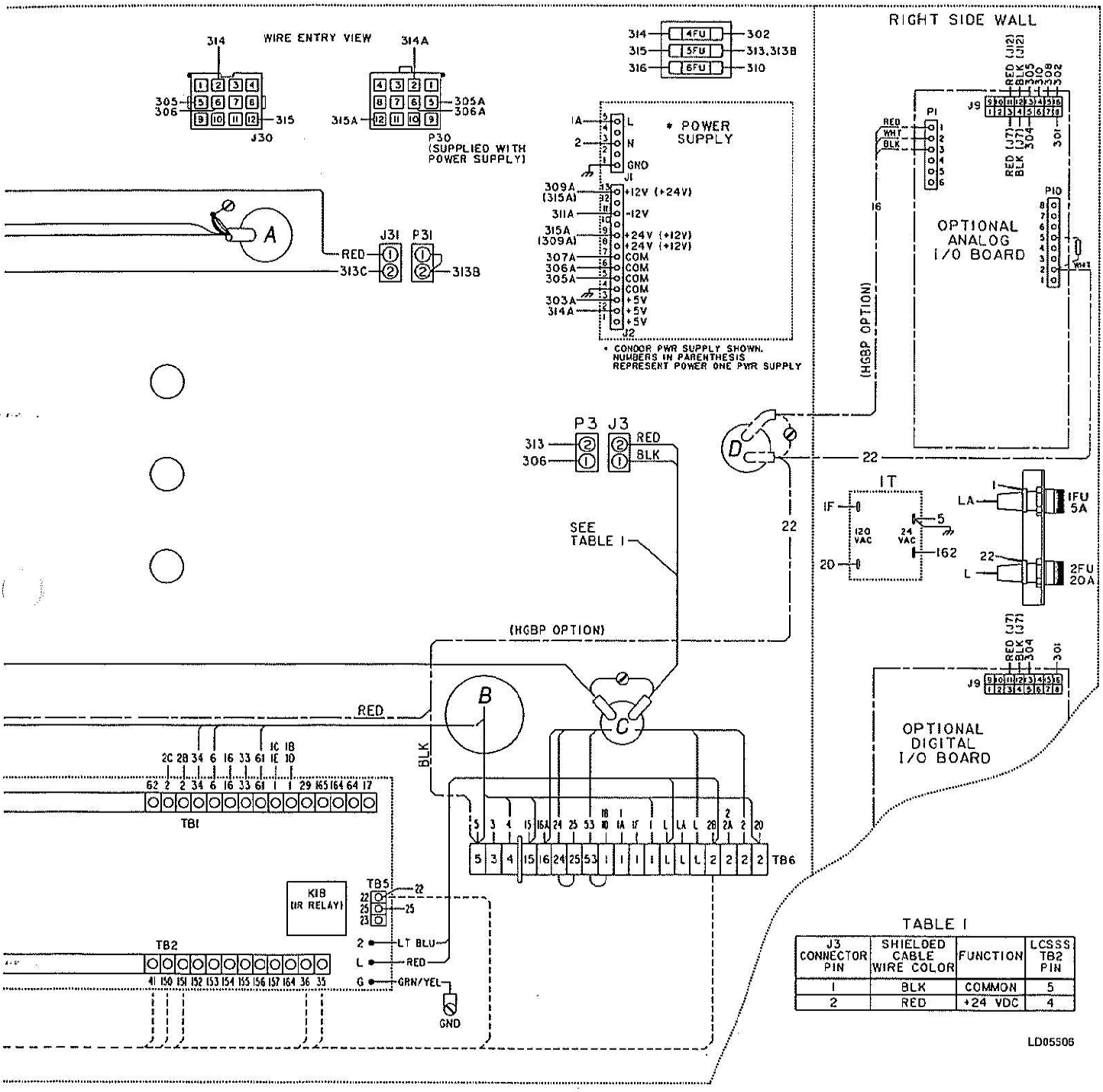
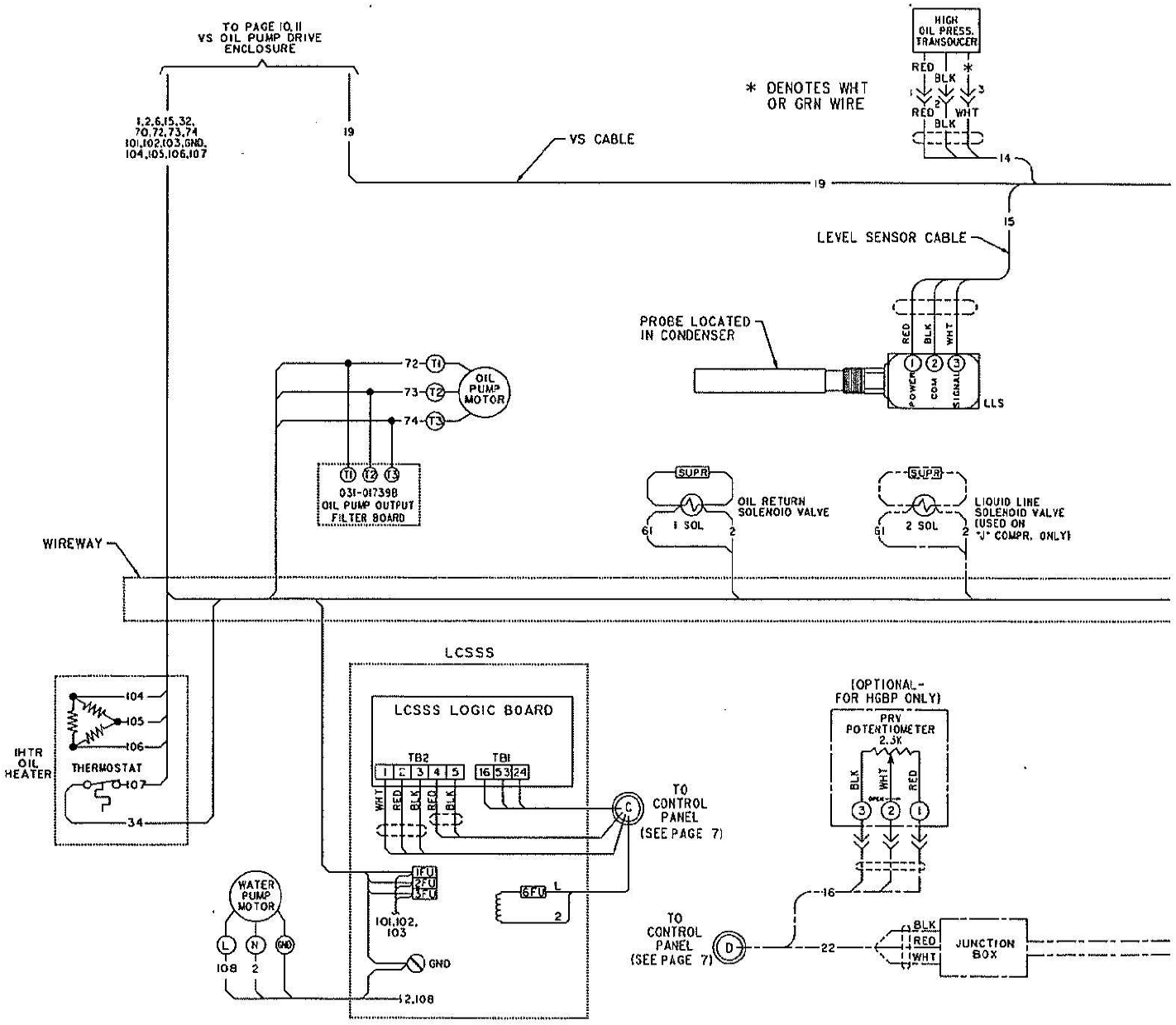


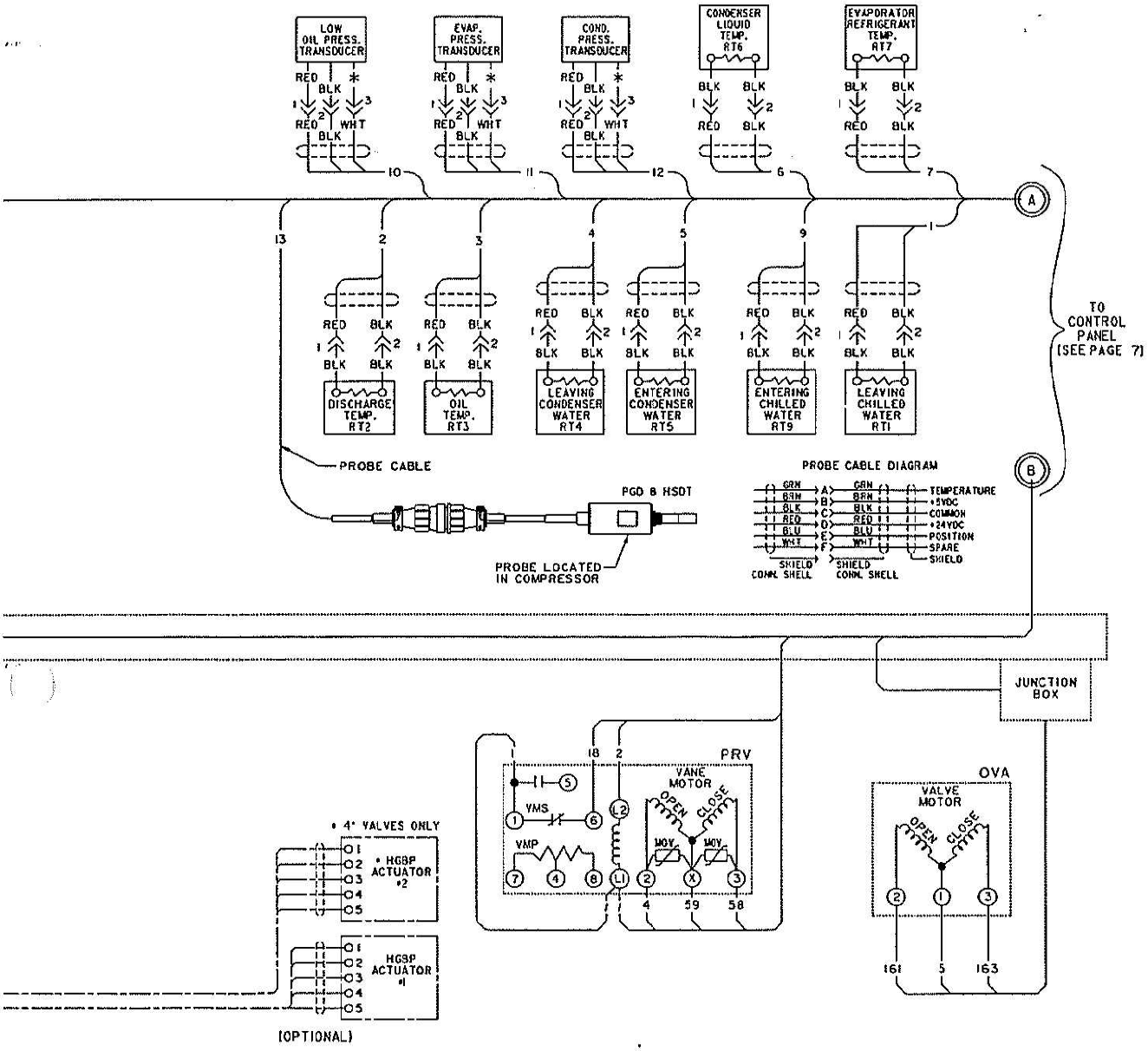
TABLE I

J3 CONNECTOR PIN	SHIELDED CABLE WIRE COLOR	FUNCTION	LCSSS TB2 PIN
1	BLK	COMMON	5
2	RED	+24 VDC	4

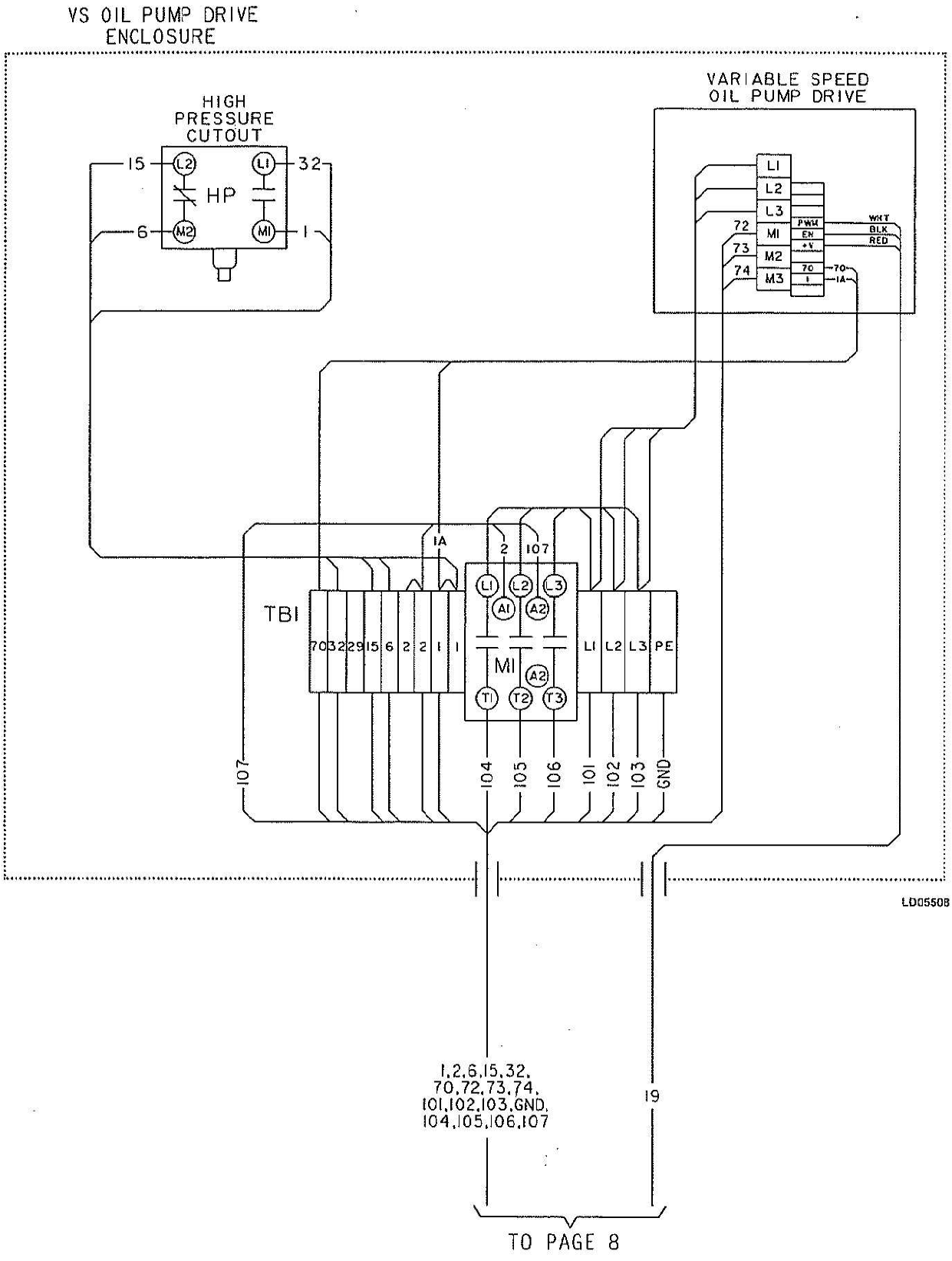
LD05506

CONNECTION DIAGRAM (Cont'd)

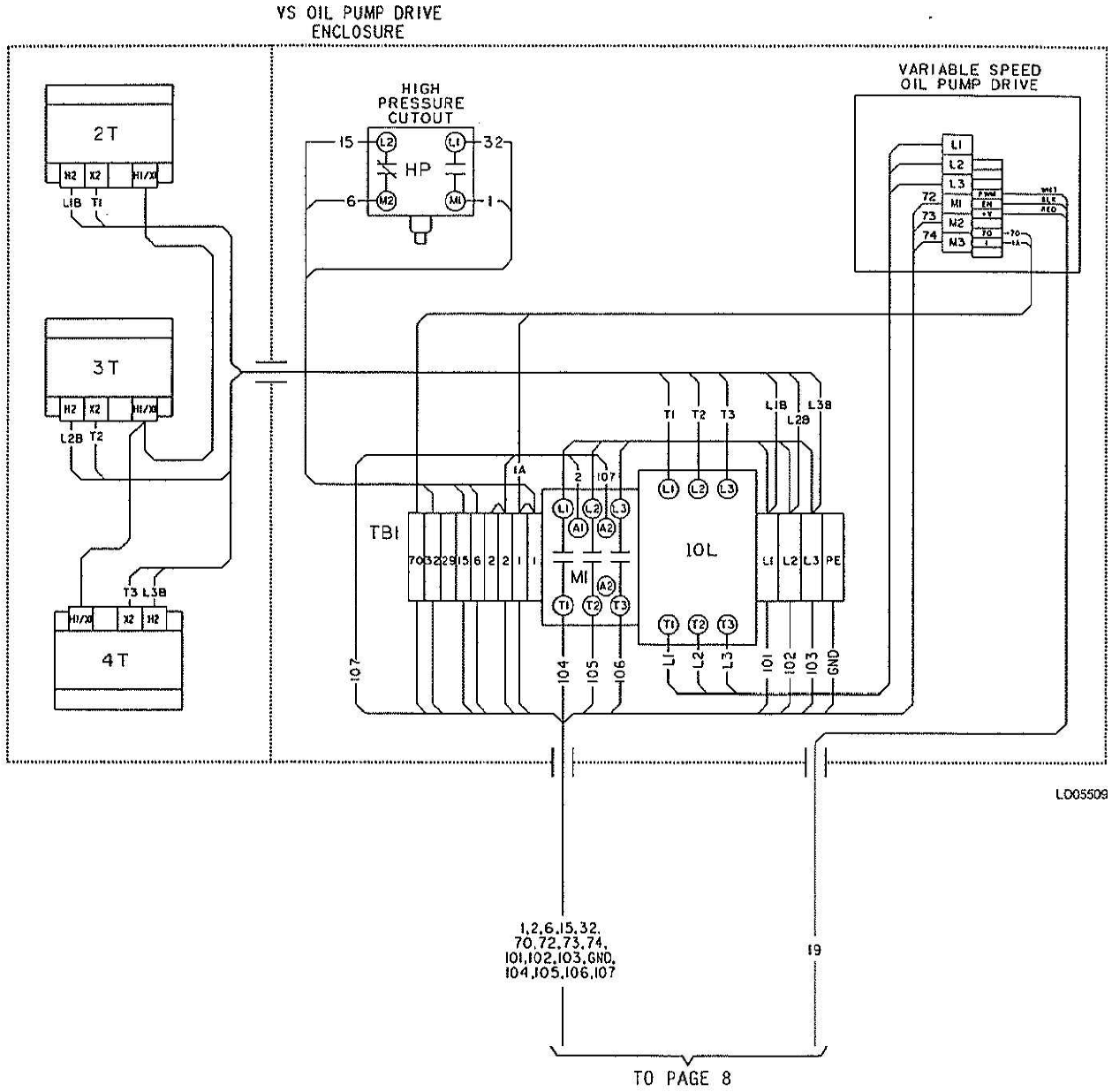



LOW OIL PRESS. TRANSDUCER
EVAP. PRESS. TRANSDUCER
COND. PRESS. TRANSDUCER
CONDENSER LIQUID TEMP. RT6
EVAPORATOR REFRIGERANT TEMP. RT7
RED
BLK
WHT
10
11
12
6
7
A
B
13
2
3
4
5
9
1
DISCHARGE TEMP. RT2
OIL TEMP. RT3
LEAVING CONDENSER WATER RT4
ENTERING CONDENSER WATER RT5
ENTERING CHILLED WATER RT9
LEAVING CHILLED WATER RT1
TO CONTROL PANEL (SEE PAGE 7)
PROBE CABLE
PGD & HSDT
PROBE LOCATED IN COMPRESSOR
PROBE CABLE DIAGRAM
GRN
BRN
BLK
RED
BLU
WHT
TEMPERATURE
+5VDC
COMMON
+24VDC
POSITION
SPARE
SHIELD
CONN SHELL
JUNCTION BOX
PRV
VANE MOTOR
OPEN
CLOSE
VMS
VMP
MOV
OVA
VALVE MOTOR
* 4" VALVES ONLY
* HGBP ACTUATOR #2
HGBP ACTUATOR #1
(OPTIONAL)

WIRING FOR 230V AND 460V UNITS



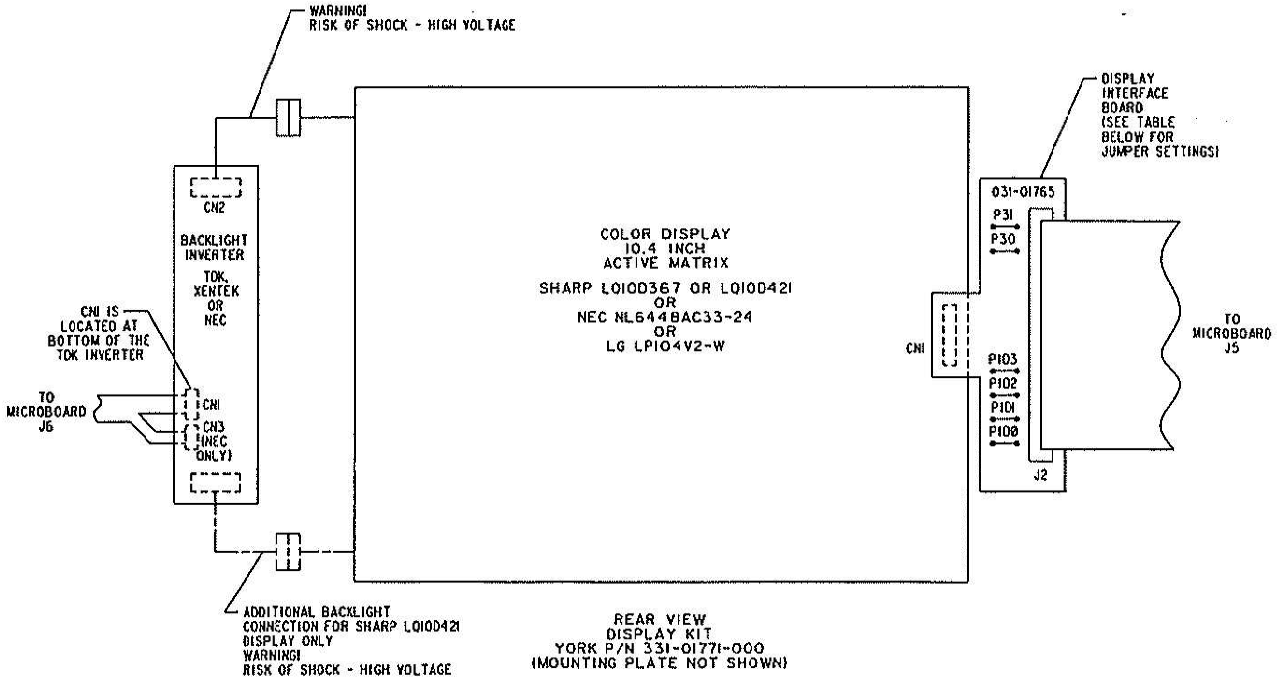
WIRING FOR 346V AND 600V UNITS

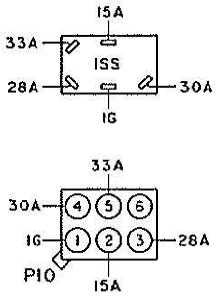


OIL PUMP MOTOR		OIL PUMP FUSING
VOLTS-PH-HZ	FULL LOAD AMPS	DUAL ELEMENT* FUSE SIZE
230-3-60	6.7	15
460-3-60	3.35	7.5
575-3-60	2.6	8#

* Oil pump motor fuses located in Solid State Starter.
\# Single element fuse size.

INSIDE VIEW OF FRONT DOOR





INSIDE VIEW OF FRONT DOOR

DISPLAY INTERFACE BOARD JUMPER SETTINGS

DISPLAY	P30	P31	PID3	PID2	PID1	PID0
SHARP LQ10D367	IN	IN	OUT	OUT	IN	OUT
SHARP LQ10D421	IN	IN	OUT	OUT	IN	OUT
NEC OR LG	OUT	OUT	OUT	OUT	OUT	IN

LD05505

PRESSURE TEMPERATURE CHART

PRESSURE-TEMPERATURE CHART							
APPLICATION		DEVICE	UNITS	OPERATING POINT			
CHILLED WATER	BRINE			ON RISE		ON FALL	
✓	✓	HDT	DEG.F/DEG.C	220/104.4		219/103.9	
✓	✓	HOT	DEG.F/DEG.C	180/82.2		179/81.7	
✓	✓	OP	PSID/kPa	25/172		15/104	
				FOR FURTHER INFORMATION, SEE OPERATOR'S MANUAL			
✓	✓	HP (R-134a)	PSIG/kPa	CUT-OUT 180/1241	INHIBIT PRV OPENING * 162.5/1120	ALLOW PRV OPENING * 160/1103	CUT-IN 120/827
✓		LEP (R-134a)	PSIG/kPa	CUT-IN 25.1/173	ALLOW PRV OPENING 28.0/193	INHIBIT PRV OPENING 27.0/186	CUT-OUT 25.0/172
	✓	ILEP	PSIG				
✓	✓	HOP	PSID/kPa	90/620.6		<90/620.6	
✓	✓	FDTS	DEG.F/DEG.C	30.0/-1.10		29.9/-1.20	
✓		LWT	DEG.F/DEG.C	PROGRAMMABLE PER OPERATOR'S MANUAL FORM 160.54-01			
	✓	LWT	DEG.F/DEG.C				
✓	✓	LOT	DEG.F/DEG.C	71.0/21.7		55.0/12.8	
✓	✓	LOTD †	DEG.F/DEG.C	30/16.7		29.9/16.6	
✓	✓	LOTD ††	DEG.F/DEG.C	40/22.2		39.9/22.1	
✓	✓	HSDT	DEG.F/DEG.C	CUT-OUT 250/121.1		CUT-IN 180/82.2 & MANUAL RESET	

** - FUNCTION PROVIDED BY CONDENSER TRANSDUCER. DEFAULT VALUES SHOWN ON TABLE. ACTUAL VALUES AS PROGRAMMED.*
*** - THIS FUNCTION IS NOT FOR ALL SHUTDOWNS - SEE OPERATOR'S MANUAL*
† - APPLICABLE IF UNIT WAS SHUTDOWN FOR 30 MINS. OR LESS
†† - APPLICABLE IF UNIT WAS SHUTDOWN FOR GREATER THAN 30 MINS.

LD05501

YORK® PRODUCT DRAWING	Supersedes: Nothing	Form 160.54-PW7 (799)
YORK INTERNATIONAL CORPORATION P.O. Box 1592, York, PA 17405	**WIRING DIAGRAM FIELD CONTROL MODIFICATIONS *MILLENNIUM*™ MODEL YK CHILLERS (STYLE E)**	
CONTRACTOR STOCKTON MECHANICAL ORDER NO. _____ YORK CONTRACT NO. 00111034 YORK ORDER NO. 1	PURCHASER _____ JOB NAME Del Castle Chiller LOCATION _____ ENGINEER DIMITRI VERVERELLI	
☐ REFERENCE DATE _____	☐ APPROVAL DATE _____	☐ CONSTRUCTION DATE _____

JOB DATA:

CHILLER MODEL NO. YK CBDBG4-CLE	CHILLER MODEL NO. YK _____
NO. OF UNITS 1	NO. OF UNITS _____
TYPE OF STARTING S.S.S.	TYPE OF STARTING _____

Included by YORK for Field Installation (by others) are:

	YES	NO	PER UNIT
One – Two Unit Sequence Control Kit, Part No. 466-61597T	☐	☐	_____
Condenser Water Temperature Sensor Kit, Part No. 375-01738-000	☐	☐	_____
Condenser Water Flow Switch	☐	☐	_____
_____	☐	☐	_____
_____	☐	☐	_____

ENERGY MANAGEMENT SYSTEMS

Millennium chiller design allows for ease of interfacing with Energy Management Systems (EMS). The Graphic Control Center includes unit status contacts, provisions for remote control inputs and provisions for remote setpoint reset of leaving chilled liquid temperature and current limit for EMS interfacing. See Note 7.

Five sets of unit status contacts are factory furnished through a field wiring terminal board in the Graphic Control Center. Each set of contacts are single pole, normally open, rated at 5 amperes resistive at 240VAC. Chiller status contacts are provided for unit:

- Remote Mode Ready to Start – See Fig. 1.
- Cycling Shutdown – See Fig. 2.
- Safety Shutdown – See Fig. 3.
- Run (System Operating) – See Fig. 4.
- Anticipatory/Alarm – See Fig. 5.

Four sets of inputs are available to the EMS, allowing for remote control of unit operation. Input device contact rating shall be 5 milliamperes at 115VAC. Field wiring terminal board (TB4) in the Graphic Control Center permits connection for the following operation:

- Remote Stop Contacts – See Fig. 6.
- Remote Start Contacts – See Fig. 6.
- Remote/Local Cycling Devices – See Fig. 7.
- Multi-unit sequence – See Fig. 8.

The chiller should not be cycled by the Energy Management System because the large motor used to drive the centrifugal compressor is limited to one start per 30 minutes. Instead, it is possible to limit the compressor motor amp draw indirectly or directly by the following methods:

1. Application of Sequence Control Kit, so only one unit is running, when a single unit can carry the cooling load – See Fig. 10.
2. When multiple unit installations are controlled by an EMS, remote start and stop contacts are available to start and stop each chiller per Fig. 6. Contact rating shall be 5 milliamperes at 115 volts A.C.

ENERGY MANAGEMENTS SYSTEMS (CONT'D)

3. The Graphic Control Center has a programmable time clock function as a standard feature with holiday capability. This offers one preset automatic Start-Stop per day on a seven day calendar basis with the ability to program a single additional holiday start and stop time up to a week in advance. Chilled water pump control contacts (see Note 13) are also provided, allowing for efficient automatic operation of the chilled water pump to reduce energy. Two chilled water pump operating modes are available via the CHW PUMP programming dip switch (position 8 of SW1) on the Micro Board. With the switch in the OFF position, the chilled water pump operates for 30 seconds prior to chiller start, during chiller operation, coastdown, and LWT cycling shutdowns. With the switch in the ON position, the chilled water pump operates as above plus it operates during MULTI-UNIT and REMOTE/LOCAL cycling shutdowns.
4. Reduce the compressor-motor kW input (and thus amps), by raising the leaving chilled liquid temperature through remote temperature control setpoint in the "remote" operating mode. When remote temperature reset is accomplished by supplying a 1 to 11 second pulse-width modulated signal, refer to Fig. 20. Through use of the remote temperature control analog input on the Micro Board, the leaving chilled liquid temperature may be reset via a 0 to 20 or 4 to 20mA D.C. current signal, a 0 to 10 or 2 to 10 volt D.C. signal.
5. Current limiting of demand during pulldown may be accomplished by using the standard PULLDOWN DEMAND LIMIT function provided in the Graphic Control Center. The "Pulldown Demand Limit" key can be programmed to limit compressor motor current from 30 to 100 percent of full load amperes, for 1 to 255 minutes following each compressor start. For more details refer to Graphic Control Center Instructions, Form 160.54-O1.
6. Controlling the maximum allowable compressor motor amps from 30 to 100% through remote current limit setpoint. Refer to Fig. 17 when the remote current limit is accomplished by supplying a 1 to 11 second pulse-width modulated signal in the "remote" operating mode. A jumper configurable analog input is available for remote current limit setpoint via a 0 to 20 or 4 to 20mA D.C. current signal, a 0 to 10 or 2 to 10 volt D.C. signal.
7. The YORK ISN System may be interfaced with the chiller Graphic Control Center to provide unified chiller plant system control. The ISN System directly communicates with the Graphic Control Center via the ISN GPIC card which may be installed in the Control Center. All temperatures, pressures, safety alarms and cycling information known to the Graphic Control Center are then available to the ISN System for integrated chiller plant control, data logging, and local and remote operator displays. The ISN GPIC card also allows the ISN to start, stop, and reset the chiller's leaving chilled water and current limit setpoints.

External wiring, unless specified as an optional connection in the manufacturer's product literature, is not to be connected inside this cabinet. Furthermore, auxiliary devices such as relays, switches, transducers and controls may not be installed inside this enclosure. All wiring must be in accordance with YORK's published specifications and must be performed only by qualified personnel. YORK will not be responsible for damages resulting from improper connection to these controls or application of improper control signals. Failure to follow this warning will void the manufacturer's warranty and may cause serious damage to property or injury to persons.

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Fig. 2 – Cycling Shutdown Contacts 4

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(2300 To 4160 Volts U.l. Or C.S.A. Approved Units Only)

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Fig. 24 – Auxiliary Safety Shutdown Input 15

Fig. 25 – Evaporator Water Pump Interlock Or Flow Switch 15

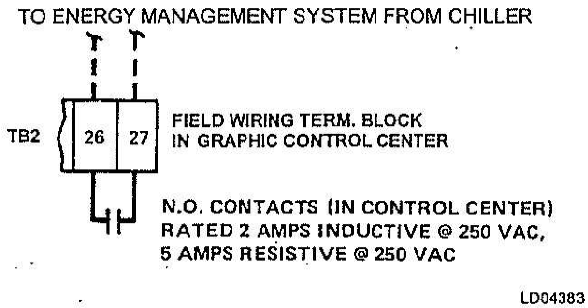

FIG. 1 – REMOTE MODE READY TO START CONTACTS

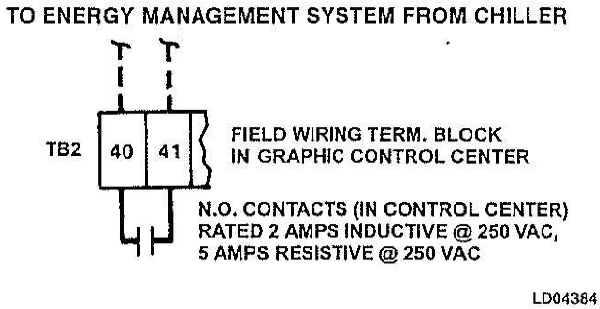

FIG. 2 – CYCLING SHUTDOWN CONTACTS

FIG. 1 – REMOTE MODE READY TO START CONTACTS

When closed, these contacts signify the following:

1. The Graphic Control Center is in "digital", "analog" or "ISN" remote operating mode, allowing for energy management system or remote start/stop control (Fig. 6);
2. All chiller safety cutout controls are in the normal position, so they will allow the unit to start;
3. All chiller cycling cutout controls are in the normal position, so they will allow the unit to start;
4. The Graphic Control Center COMPRESSOR switch is in the "RUN" (I) position;
5. The 30 minute anti-recycle timer has timed out. A closure of the Remote Mode Ready to Start Contacts then signifies that the unit shall start when the Energy Management System maintains the Remote Stop contact (Fig. 6) open and momentarily closes the Remote Start Contact (Fig. 6). When the Remote Mode Ready to Start Contacts close, the Graphic Control Center will display the following message: "SYSTEM READY TO START".

FIG. 2 – CYCLING SHUTDOWN CONTACTS

When closed, these contacts signify the unit is not permitted to start due to a CYCLING shutdown condition. The unit will automatically restart after the cycling condition is no longer present. YORK Operating and Maintenance Manual 160.54-O1 provides a list and explanation of all Cycling shutdowns. While these contacts are closed, the Graphic Control Center will display "Cycling Shutdwon – Auto Restart" on the System Status Bar and the cause of the shutdown on the System Details bar of the display. Cycling Shutdwon contacts function in all operating modes.

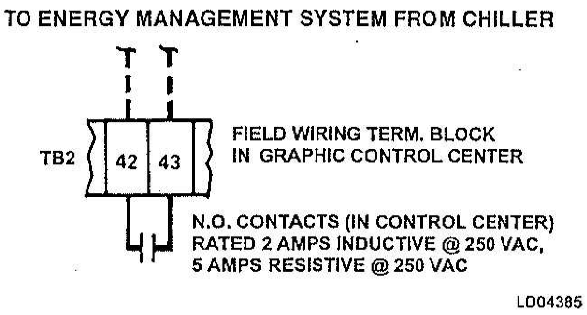

FIG. 3 – SAFETY SHUTDOWN CONTACTS

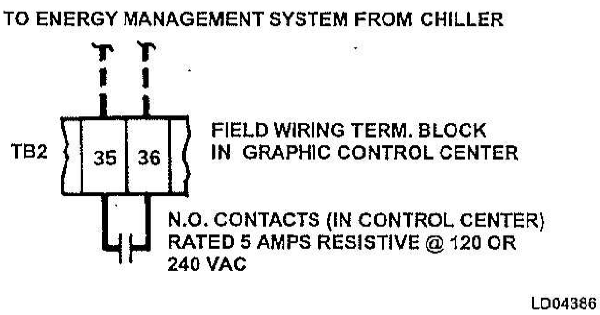

FIG. 4 – RUN CONTACTS

FIG. 3 – SAFETY SHUTDOWN CONTACTS

When closed, these contacts signify the unit is not permitted to start due to a SAFETY shutdown condition. Safety shutdowns require a manual reset procedure be performed before the unit can be restarted. YORK Operating and Maintenance Manual 160.54-O1 provides a list and explanation of all Safety shutdowns. While these contacts are closed, the Graphic Control Center will display "Safety Shutdown – Manual Restart" on the System Status Bar and the cause of the shutdown on the System Details Bar of the display. These contacts will remain closed until the safety condition no longer exists and a manual reset is performed by placing the Graphic Control Center COMPRESSOR Switch in the Stop-Reset position (O). The unit can then be restarted. Safety Shutdown contacts function in all operating modes.

FIG. 4 – RUN CONTACTS

When closed, these contacts signify that the unit is operating. The Graphic Control Center will display a System Run Message.

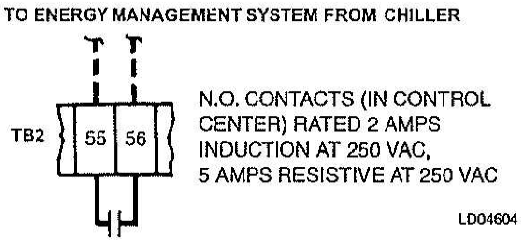

FIG. 5 – ANTICIPATORY/ALARM CONTACTS

FIG. 5 – ANTICIPATORY/ALARM CONTACTS

These contacts will close whenever one or more of the following WARNING conditions occurs. They will remain closed as long as the condition is in effect. On most Warnings, the contacts automatically open when the condition is no longer present. On those warnings marked with an asterisk, the contacts will open only after the condition is no longer present and the WARNING RESET key is pressed in Operator (or higher) access level.

Real time Clock failure, Condenser or Evaporator Transducer Error*, Refrigerant level Out Of range, Standby Lube – Low Oil Pressure*, Setpoint Override*, Condenser-High Pressure Limit, Evaporator-Low Pressure Limit, Vanes Uncalibrated – Fixed speed, Harmonic filter – Operation Inhibited, Harmonic Filter – Data Loss, Harmonic Filter – Input Frequency Out of Range.

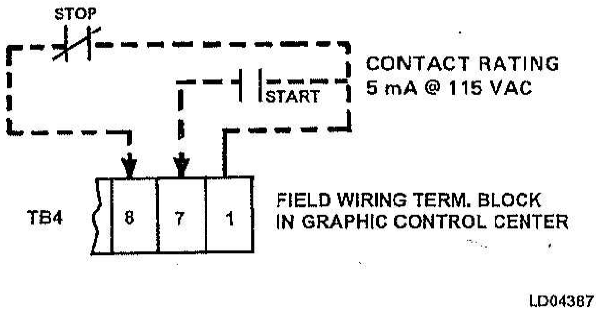

FIG. 6 – REMOTE START-STOP CONTACTS FROM ENERGY MANAGEMENT SYSTEM

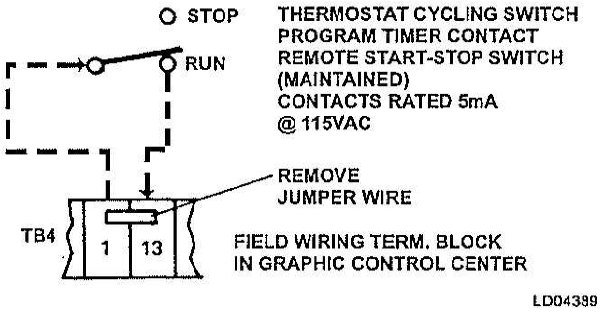

FIG. 7 – REMOTE/LOCAL CYCLING DEVICES

FIG. 6 – REMOTE START AND STOP CONTACTS FROM ENERGY MANAGEMENT SYSTEM

When the Graphic Control Center is in the "Digital", "Analog" or "ISN" remote operating mode and the COMPRESSOR switch is in the "RUN" (I) position, with the Remote Stop Contacts open, and the Remote Mode Ready to Start Contacts closed (Fig. 1), the unit will start via a closure of the Remote Start Contacts. A subsequent closure of the Energy Management System Remote Stop Contacts causes the chiller to shut down. The Graphic Control Center will display "REMOTE STOP" because the Energy Management System Remote Stop Contact has commanded the unit to shut down.

It is recommended that maintained contacts be used for both START and STOP.

NOTE

Even when the chiller is applied with Remote Start-Stop (when the Control Center is in the "remote operating mode), an EMERGENCY STOP by an operator or others can STOP the compressor from the Graphic Control Center and prevent the chiller from restarting. However, the operator cannot locally start the compressor using "compressor" start switch, when the control center is in the "remote" operating mode.

FIG. 7 – REMOTE/LOCAL CYCLING DEVICES

The closure of an automatic reset device across this input will permit the unit to operate in all operating modes. Conversely, an opening of the device contacts will inhibit the unit from operating; the Graphic Control Center will then display the following messages: "CYCLING SHUTDOWN – AUTO RESTART" and "SYSTEM CYCLING – CONTACTS OPEN".

NOTE

The Graphic Control Center contains a seven day time clock to select daily schedule Start/Stop times (Sunday through Saturday including one or more holidays in week) up to one full week at a time. So automatic start and stop of the unit on a daily basis, at predetermined times, can be programmed as a standard feature; an additional program timer is not required for this function.

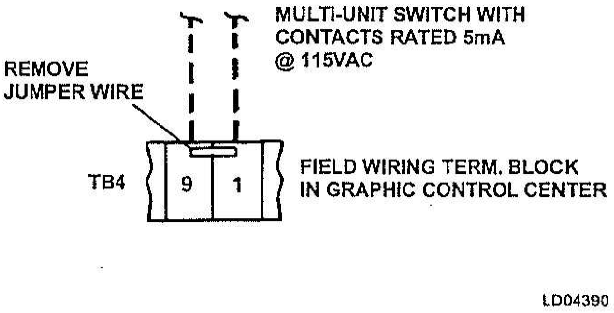

FIG. 8 – MULTI-UNIT SEQUENCE

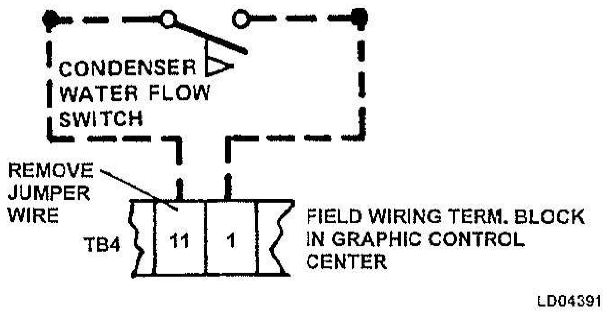

FIG. 9 – CONDENSER WATER FLOW INTERLOCK

FIG. 8 – MULTI-UNIT SEQUENCE

For multiple chiller installation application, Multi-Unit Sequence contacts are available to start and stop each unit. The maintained closure of a device contacts across terminals [1] and [9] will permit the unit to operate in all the operating modes with the "compressor" switch in the "RUN" (I) position. Conversely, an opening of the device contacts will inhibit the unit from operating; the Graphic Control Center will then display the following message: "CYCLING SHUTDOWN – AUTO RESTART" and "MULTIUNIT CYCLING – CONTACTS OPEN". An accessory sequence control kit for two, three or four units is available from YORK – See Fig. 10 for Two Unit Sequence Control kit.

FIG. 9 – CONDENSER WATER FLOW INTERLOCK

If desired, a condenser water flow interlock can be applied. Flow switch – McDonnel type FS8W, max. 150 psi (YORK Part No. 024-15793) available at additional cost. If condenser water flow switch is not used, a jumper must be installed between terminals [1] and [11].

When condenser water is flowing, the flow switch contact will close. Opening of the condenser water flow switch contacts for 2 continuous seconds will cause unit shutdown. The Flow Switch Status is checked 30 seconds into "System Run" and continuously thereafter. The Graphic Control Center will display the following message: "CYCLING SHUTDOWN – AUTO RESTART" and "CONDENSER FLOW SWITCH OPEN".

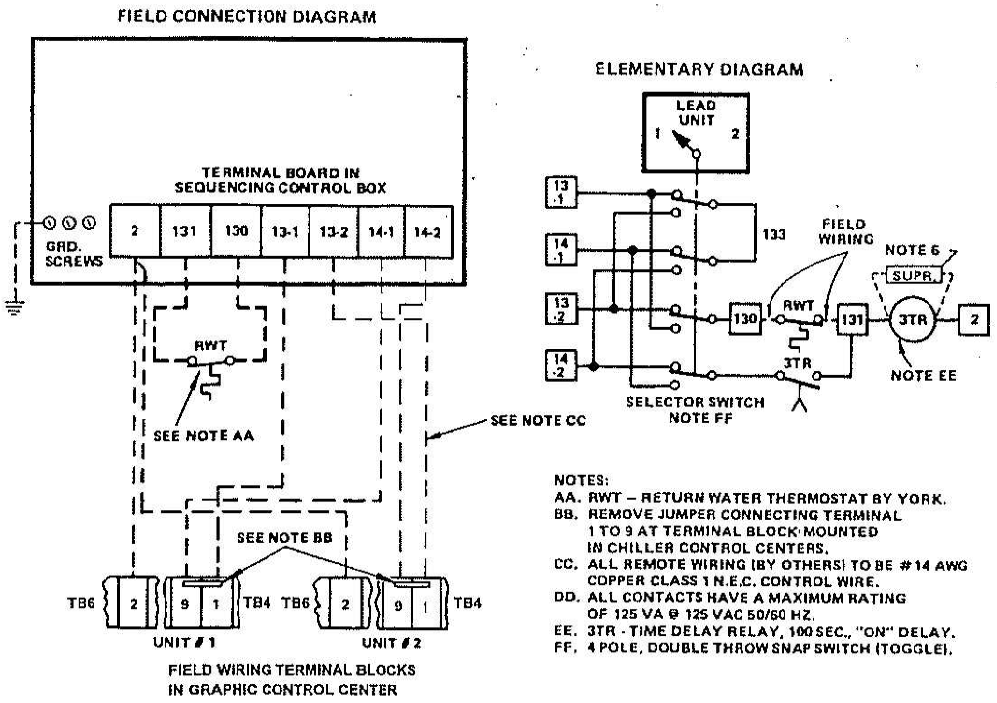

FIG. 10 – TWO UNIT SEQUENCE CONTROL

FIG. 10 – TWO UNIT SEQUENCE CONTROL

Provides that cycling thermostat RWT will automatically cycle either #1 or #2 unit. Timer 3TR is an additional feature which prevents simultaneous starting of lead and lag unit following a power failure and eliminates nuisance starting of lag unit due to periodic fluctuations in temperature. For two unit sequence control kit, order YORK Accessory Kit No. 466-61597T for controls as specified with NEMA 1 enclosure.

RWT has 20°F to 80°F range with adjustable differential of 3-1/2 to 14°F; 6 ft. of capillary with 3/8" x 5" bulb and 1/2" NPT brass well (maximum liquid DWP 300 PSIG). The thermostat is drawn to indicate its operation closes on rise. A 1/2" pipe coupling in the return chilled water line from the building must be furnished (by others) for RWT control well.

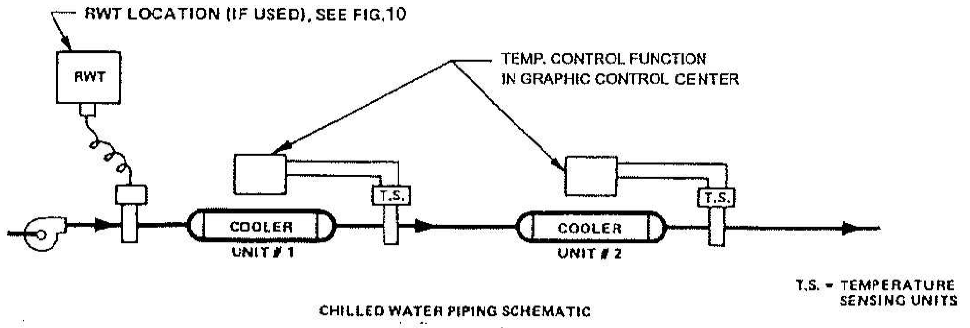

FIG. 11 – MULTIPLE UNITS (TWO) – SERIES OPERATION (NOTES 8 & 11)

FIG. 11 – MULTIPLE UNITS (TWO) – SERIES OPERATION

The supply chilled water temperature to the building is normally determined by the "chilled liquid temp." setpoint for Unit #2. When lead selector position of sequence control kit (Fig. 10) is Unit #1, the supply chilled water temperature to the building will be the temperature control setpoint on Unit #1 Graphic Control Center. If lower temperature is desired, reprogram the "chilled liquid temp." setpoint for Unit #1.

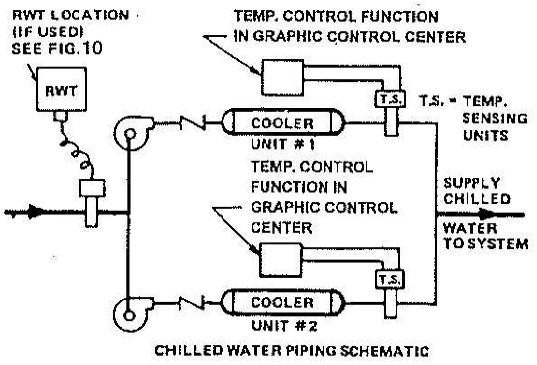

FIG. 12 – MULTIPLE UNITS (TWO) – PARALLEL OPERATION – INDIVIDUAL UNIT PUMPS

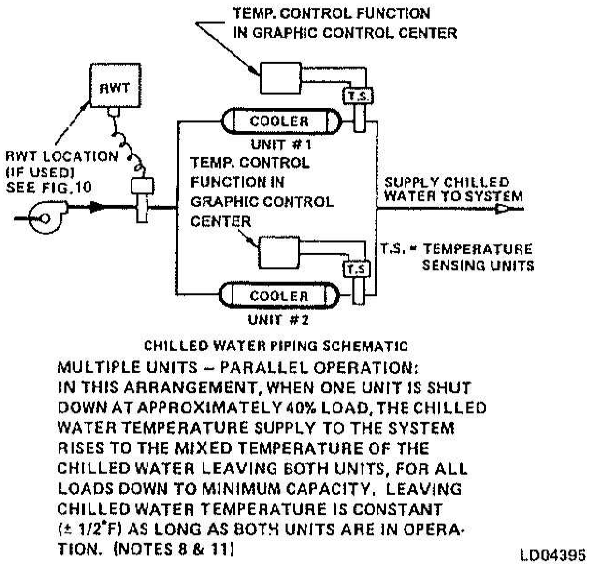

FIG. 13 – MULTIPLE UNITS (TWO) – PARALLEL OPERATION – SINGLE CHILLED WATER PUMP

FIG. 12 – MULTIPLE UNITS (TWO) – PARALLEL OPERATION – INDIVIDUAL UNIT PUMPS

This piping arrangement is the same as Fig. 13, except that the chilled water pumps associated with each cooler (evaporator) are cycled on and off with the unit. This results in reduced chilled water flow rates whenever a single unit can handle the cooling load. Because no chilled water flows through the inoperative unit, the mixed water temperature peculiar to using a single pump is avoided. When one unit is cut-out by the sequence control (Fig. 10) the temperature of the supply chilled water does not change.

FIG. 13 – MULTIPLE UNITS (TWO) – PARALLEL OPERATION – SINGLE CHILLED WATER PUMP

For this piping arrangement, each chiller's water sensor is located in its own leaving water nozzle. This produces a constant "mixed" chilled water temperature when both units are operating. When either unit is cycled off by the sequence control (Fig. 10), mixed chilled water temperature will rise as a result of uncooled return water flowing through the inoperative unit. For individual unit chilled water pump piping, refer to Fig. 12.

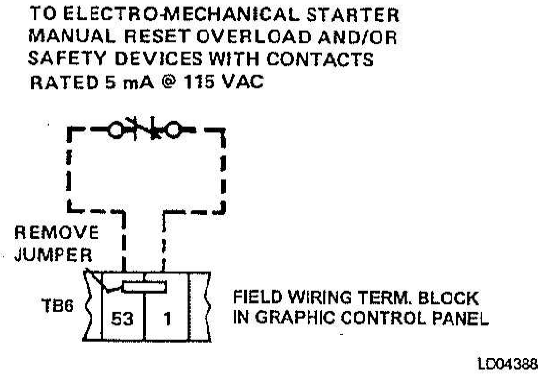

FIG. 14 – ELECTRO-MECHANICAL STARTER MANUAL RESET OVERLOADS (2300 to 4160 Volts U.L. or C.S.A. approved units only)

FIG. 14 – ELECTRO-MECHANICAL STARTER MANUAL RESET OVERLOADS

Terminals are available for connection of the manual reset overloads and/or safety devices in the high voltage electro-mechanical starter for U.L. or C.S.A. approved units having 2300 to 4160 volt motors. See Remote Motor Starter (E-M) specifications, Product Drawing Form 160.45-PA5.1. An opening of the contacts causes the Graphic Control Center to display: "CYCLING SHUTDOWN – AUTO RESTART" and "MOTOR CONTROLLER – CONTACTS OPEN". To restart the chiller, reset the external device in the electro-mechanical starter that caused the shutdown. Then the unit will automatically restart.

REMOTE CURRENT LIMIT SETPOINT with 0-10VDC, 2-10 VDC, 0-20mA, 4-20mA or Pulse Width Modulation Signal.

The Remote Current Limit setpoint can be reset over the range of 100% to 30% Full Load Amps (FLA) by supplying (by others) a 0-10VDC, 2-10VDC, 0-20mA, 4-20mA or 1 to 11 second Pulse Width Modulated (PWM) signal to the Graphic Control Center. The Graphic Control Center must be configured appropriately to accept the desired signal type as follows:

- The appropriate Remote Mode must be selected: **Analog** Remote Mode must be selected when using a voltage or current signal input. **Digital** Remote Mode must be selected when using a PWM input.
- If **Analog** Remote Mode is selected, the **Remote Analog Input Range** setpoint must be set to "0-10VDC" or "2-10VDC" as detailed below, regardless of whether the signal is a voltage or current input signal type.
- Micro Board Program Jumper P23 must be positioned appropriately per the input signal type as detailed below. It is recommended that a qualified Service Technician position this jumper.

NOTE

Important! The signal type used for Remote Current Limit Setpoint reset and the signal type used for Remote Leaving Chilled Liquid Temperature setpoint reset must be the same. For example, if a 0-10VDC signal is being used for Remote Leaving Chilled Liquid Temperature Reset, then a 0-10VDC signal must be used for Remote Current Limit Reset.

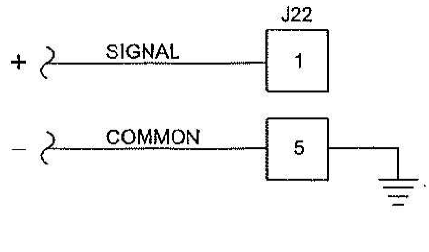

FIG. 15 – REMOTE CURRENT LIMIT SETPOINT WITH 0-10VDC OR 2-10VDC SIGNAL

0-10VDC - As shown in Fig. 15, connect input to Micro Board J22-1 (signal) and J22-5 (Gnd). The setpoint varies linearly from 100% to 30% FLA as the input varies from 0-10VDC. This input will only be accepted when **Analog** Remote Mode is selected, the **"Remote Analog Input Range"** setpoint is set for 0-10 Volts, and Micro Board Program Jumper JP23 has been removed. Calculate the setpoint for various inputs as follows:

$$\text{SETPOINT (\%)} = 100 - (\text{VDC} \times 7)$$

For example, if the input is 5VDC, the setpoint would be set to 65% as follows:

$$\text{SETPOINT (\%)} = 100 - (5 \times 7) = 100 - 35 = 65\%$$

2-10VDC - As shown in Fig. 15, connect input to Micro Board J22-1 (signal) and J22-5 (Gnd). The setpoint varies linearly from 100% to 30% FLA as the input varies from 2 to 10VDC. This input will only be accepted when **"Analog"** Remote Mode is selected, the **"Remote Analog Input Range"** setpoint is set for "2-10 Volts" and Micro Board Program Jumper JP23 has been removed. Calculate the setpoint for various inputs as follows:

$$\text{SETPOINT (\%)} = 100 - [(\text{VDC} - 2) \times 8.75]$$

For example, if the input is 5VDC, the setpoint would be set to 74% as follows:

$$\text{SETPOINT (\%)} = 100 - [(5-2) \times 8.75]$$

$$= 100 - [3 \times 8.75]$$

$$= 100 - 26.25 = 74\%$$

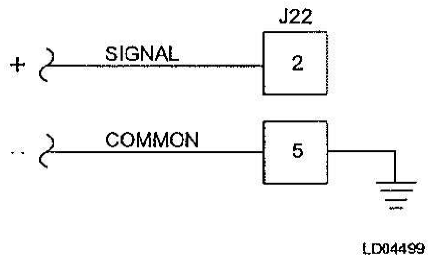

FIG. 16 – REMOTE CURRENT LIMIT SETPOINT WITH 0-20mA OR 4-20mA SIGNAL

0-20 mA - As shown in Fig. 16, connect input to Micro Board J22-2 (signal) and J2-5 (Gnd). The setpoint varies linearly from 100% to 30% FLA as the input varies from 0mA to 20mA. This input will only be accepted when **"Analog"** Remote Mode is selected, the "Re-

- Micro Board Program Jumper JP24 must be positioned appropriately per the input signal type as detailed below. It is recommended a qualified Service Technician position this jumper.

NOTE

Important! The signal type used for Remote Leaving Chilled Liquid Temperature setpoint reset and the signal type used for Remote Current Limit setpoint reset must be the same. For example, if a 0-10VDC signal is being used for Remote Current Limit Setpoint, then a 0-10VDC signal must be used for Leaving Chilled Liquid Temperature reset.

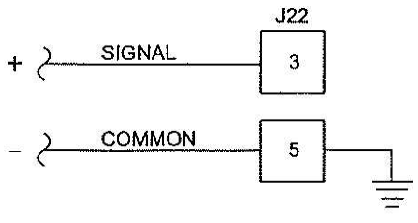

FIG. 18 – REMOTE LEAVING CHILLED LIQUID TEMP. SETPOINT WITH 0-10VDC OR 2-10 VDC SIGNAL

0-10VDC - As shown in Fig. 18, connect input to Micro Board J22-3 (signal) and J22-5 (Gnd). A 0VDC signal produces a 0°F offset. A 10VDC signal produces the maximum offset (10 or 20°F above the Local Setpoint value). The setpoint is changed linearly between these extremes as the input varies linearly over the range of 0VDC to 10VDC. This input will only be accepted when **"Analog" Remote Mode** is selected., the **"Remote Analog Input Range"** setpoint is set for "0-10VDC" and Micro Board Program Jumper JP24 has been removed. Calculate the setpoint for various inputs as follows:

$$\text{OFFSET(°F)} = \frac{\text{(VDC)(REMOTE RESET TEMP. RANGE)}}{10}$$

$$\text{SETPOINT(°F)} = \text{LOCAL SETPOINT} + \text{OFFSET}$$

For example, if the input is 5VDC and the Remote Reset Temp Range setpoint is programmed for 10°F and the Local Leaving Chilled Liquid Temperature setpoint is programmed for 40°F, the setpoint would be set to 45°F as follows:

$$\text{OFFSET (°F)} = \frac{5 \times 10}{10}$$

$$= \frac{50}{10}$$

$$= 5°F$$

$$\text{SETPOINT (°F)} = 40 + 5$$

$$= 45°F$$

2-10VDC - As shown in Fig. 18, connect input to Micro Board J22-3 (signal) and J2-5 (Gnd). A 2VDC signal produces a 0°F offset. A 10VDC signal produces the maximum allowed offset (10°F or 20°F above the Local Setpoint Value). The setpoint is changed linearly between these extremes as the input varies over the range of 2VDC to 10VDC. This input will only be accepted when **"Analog" Remote Mode** is selected, the **"Remote Analog Input Range"** setpoint is set for "2-10VDC" and the Micro Board Program Jumper JP24 has been removed. Calculate the setpoint for various inputs as follows:

$$\text{OFFSET (°F)} = \frac{\text{(VDC} - 2)\text{(REMOTE RESET TEMP. RANGE)}}{8}$$

$$\text{SETPOINT (°F)} = \text{LOCAL SETPOINT} + \text{OFFSET}$$

For example, if the input is 5VDC and the Remote Reset Temp. Range setpoint is programmed for 40°F, the setpoint would be set to 43.8°F.

$$\text{OFFSET (°F)} = \frac{(5-2)(10)}{8}$$

$$= \frac{(3)(10)}{8}$$

$$= \frac{30}{8}$$

$$\text{SETPOINT (°F)} = 40 + 3.8$$

$$= 43.8°F$$

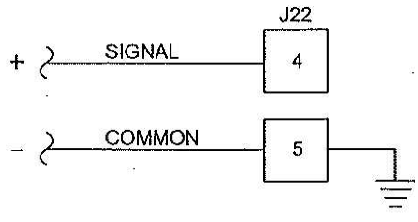

FIG. 19 – REMOTE LEAVING CHILLED LIQUID TEMP. SETPOINT WITH 0-20MA OR 4-20MA SIGNAL

0-20mA - As shown in Fig. 19, connect input to Micro Board J22-4 (signal) and J22-5 (Gnd). A 0mA signal produces a 0°F offset. A 20mA signal produces the maximum allowed offset (10 or 20°F above the local setpoint value). The setpoint is changed linearly between these extremes as the input varies over the range of 0-20mA. This input will only be accepted when **"Analog" Remote Mode** is selected, the **"Remote Analog Input Range"** setpoint is set for "0-10VDC" and Micro Board Program Jumper J24 has been placed on pins 1 and 2. Calculate the setpoint for various inputs as follows:

$$\text{OFFSET (°F)} = \frac{(\text{MA})(\text{REMOTE RESET TEMP RANGE})}{20}$$

$$\text{SETPOINT(°F)} = \text{LOCAL SETPOINT} + \text{OFFSET}$$

For example, if the input is 8mA, the Remote Reset Temp Range Setpoint is programmed for 10°F and the Local Leaving Chilled Liquid Temperature setpoint is programmed for 40°F, the setpoint would be set to 44°F as follows:

$$\text{OFFSET(°F)} = \frac{(8)(10)}{20}$$

$$= \frac{80}{20}$$

$$= 4\text{°F}$$

$$\text{SETPOINT (°F)} = 40 + 4$$
$$= 44\text{°F}$$

4-20mA - As shown in Fig. 19, connect input to Micro Board J22-4 (signal) and J22-5 (Gnd). A 4mA signal produces a 0°F offset. A 20mA signal produces the maximum allowed offset (10 or 20°F above the Local setpoint Value). The setpoint is changed linearly between these extremes as the input varies over the range of 0-20mA. This input will only be accepted when **"Analog" Remote Mode** is selected, the **"Remote Analog Input Range"** setpoint is set for "2-10VDC" and Micro Board Program Jumper JP24 has been placed on pins 1 and 2. Calculate the setpoint for various inputs as follows:

$$\text{OFFSET(°F)} = \frac{(\text{MA} - 4)(\text{REMOTE TEMP. RESET RANGE})}{16}$$

$$\text{SETPOINT(°F)} = \text{LOCAL SETPOINT} + \text{OFFSET}$$

For example, if input is 8mA, and the Remote Reset Temp Range setpoint is programmed for 10°F and the Local Leaving Chilled Liquid Temperature setpoint is programmed for 40°F, the setpoint would be set to 42.5°F as follows:

$$\text{OFFSET(°F)} = \frac{(8-4)(10)}{16}$$

$$= \frac{(4)(10)}{16}$$

$$= \frac{40}{16}$$

$$= 2.5\text{°F}$$

$$\text{SETPOINT(°F)} = 40 + 2.5$$

$$= 42.5\text{°F}$$

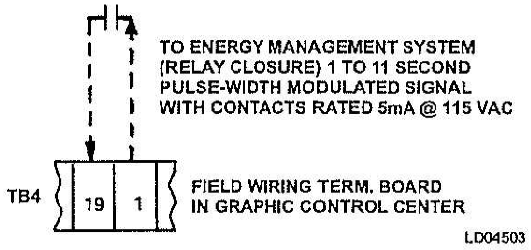

FIG. 20 – REMOTE LEAVING CHILLED LIQUID TEMPERATURE SETPOINT WITH PWM SIGNAL

PWM – The Pulse Width Modulation input is in the form of a 1 to 11 second relay contact closure that applies 115VAC to the I/O Board TB4-19 for 1-11 seconds. As shown in Fig. 20, connect dry closure relay contacts between I/O Board TB4-19 (input) and TB4-1 (115VAC). A contact closure time (pulse width) of 1 second produces a 0°F offset. An 11 second closure produces the maximum allowed offset (10 or 20°F above the local setpoint value). The relay contacts should close for 1 to 11 seconds at least once every 30 minutes to maintain the setpoint to the desired value. If a 1 to 11 second closure is not received within 30 minutes of the last closure, the setpoint is defaulted to the Local setpoint value. A closure is only accepted at rates not to exceed once every 70 seconds. This input will only be accepted in **"Digital" Remote Mode**. Calculate the setpoint for various pulse widths as follows:

$$\text{OFFSET(°F)} = \frac{(\text{PULSE WIDTH IN SECONDS})(\text{REMOTE RESET TEMP. RANGE})}{10}$$

$$\text{SETPOINT(°F)} = \text{LOCAL SETPOINT} + \text{OFFSET}$$

For example, if the relay contacts close for 5 seconds and the Remote Reset Temp Range setpoint is programmed for 10°F, and the Local Leaving Chilled Liquid Temperature setpoint is programmed for 40°F, the setpoint would be set to 44°F as follows:

$$\text{OFFSET (°F)} = \frac{(5-1)(10)}{10}$$

$$= \frac{(4)(10)}{10}$$

$$= \frac{40}{10}$$

$$= 4°F$$

$$\text{SETPOINT (°F)} = 40 + 4$$

$$= 44°F$$

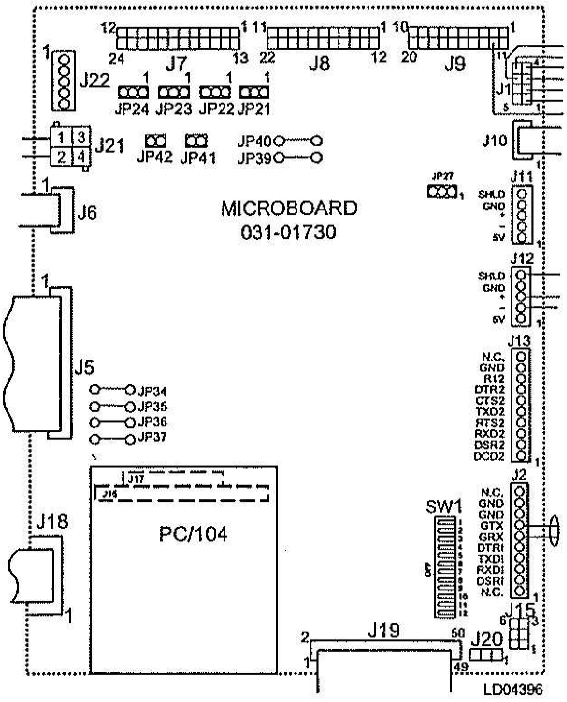

FIG. 21 – MICRO BOARD DIP SWITCH FOR AUTO/ MANUAL RESTART AFTER POWER FAILURE

FIG. 21 – MICRO BOARD DIP SWITCH FOR POWER FAILURE RESTART

This figure shows the location of the **Power Failure Restart Dip Switch** on the Micro Board. The Micro Board is mounted on the rear panel located directly behind the Graphic Control Center door. Refer to the Connection Diagram page of Wiring Diagram, Form 160.54-PW4 (with Electro-Mechanical Starter), Form 160.54-PW5 (with Solid State Starter), or Form 160.54-PW6 (with Variable Speed Drive). For orientation purposes with the Connection Diagram, see Fig. 21.

1. Power Failure Restart Dip Switch - The Control Panel is furnished for Manual Restart After Power Failure as a standard function. The Control Panel can be field-changed to **Automatic** Restart after a power failure if the **Manual** Restart feature is not desired. Simply place position 5 of the 12-position Dip Switch (SW1) on ON and the **Automatic** Restart feature will be enabled. Place to the OFF position to return to **Manual** Restart.

2. English/Metric Display Units Configuration – The Control Panel can present data on the Graphic Display in English or Metric Units. In Operator Access Level, from the HOME screen, press the **"Setpoints"** key to go to the SETPOINTS screen. Next, press the **"Setup"** key to go to the SETUP screen. Press the **"User"** key to go the USER SETUP screen. Press the **"English/Metric Units"** key to select the desired units. The data field will toggle between English and Metric with each press of the " ◀ **or** ▶ " key. For English Units, the temperature display is in degree Fahrenheit (°F), and absolute pressure is in pounds per square inch (psia). For Metric Units, temperature is in degrees Celsius (°C), and pressure in KiloPascals (kPa).

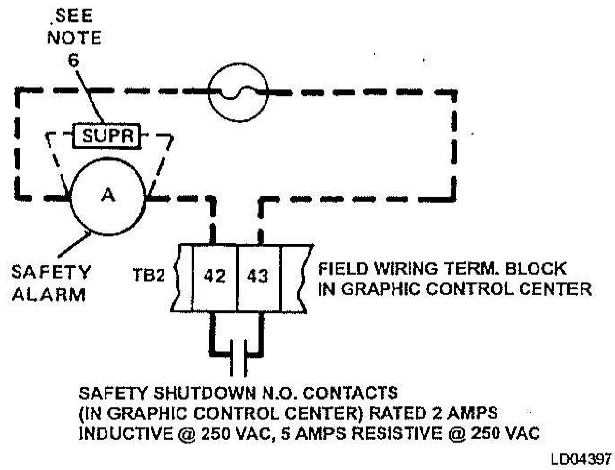

FIG. 22 – EXTERNAL SIGNAL FOR REFRIGERATION UNIT FAILURE (NOTE 6)

FIG. 22 – EXTERNAL SIGNAL FOR REFRIGERATION UNIT FAILURE

When the Safety Shutdown Contacts (see Fig. 3) are not connected to an Energy Management System they may be employed to energize a local or remote safety alarm (by others). When the normally open Safety Shutdown Contacts close, the alarm will indicate shutdown of the unit. The cause of shutdown will be one or more of the following safety controls: low oil pressure; high oil pressure; high condenser pressure; low evaporator pressure; high oil temperature; high discharge temperature; auxiliary safety; power failure when the **"Auto Restart After Power Failure"** Dip Switch on the Micro Board (Fig. 21) is in the OFF position (SW1, position 5 = OFF), which implies that the chiller requires **"Manual Restart After Failure"**.

On solid state starter units only, when the **Current Imbalance** option is selected via the Solid State Starter screen, three phase current imbalance protection is provided. A safety shutdown occurs (following a 45 second by-pass at startup) whenever the % FLA readout exceeds 80% for 45 seconds continuously and the % imbalance is ≥ 30%. When all safety controls are satisfied, and the Graphic Control Center COMPRESSOR switch has been manually "Reset" (de-energizing alarm) and returned to the RUN position ("1"), the unit may be restarted, if panel is in "Remote" mode, via the Remote Start contacts (Fig. 6); or, if panel is in "local" mode by momentarily pressing the keypad compressor switch to the START (" ◀ ") position.

NOTE

If the unit was shut down because of Cycling Shutdown Contacts (see Fig. 2) the alarm will not be energized, but the unit will have been shut down. A closure of the safety alarm contacts means that an operator must manually reset and restart the unit.

When the Safety Shutdown contacts close, the Graphic Control Center will display the following message: "SAFETY SHUTDOWN – MANUAL RESTART", and cause of shutdown.

ELEMENTARY DIAGRAM

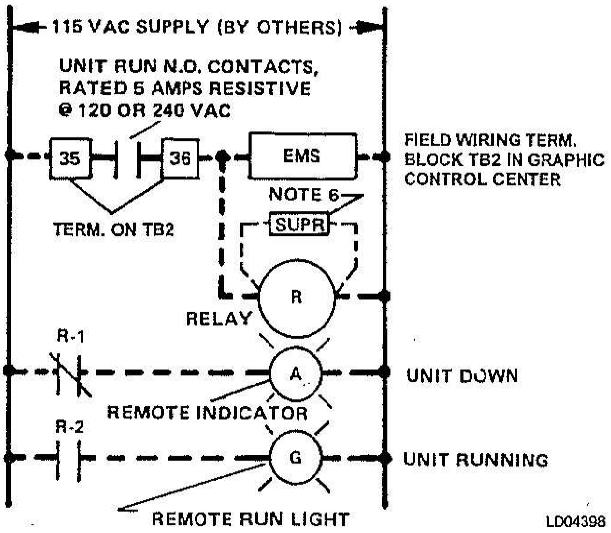

FIG. 23 – RUN CONTACTS / REMOTE RUN LIGHT AND SHUTDOWN INDICATOR PLUS EMS

FIG. 23 – RUN CONTACTS/REMOTE RUN LIGHT AND SHUTDOWN INDICATOR PLUS EMS

When run contacts are required for a Remote Run Light and/or Shutdown Indicator AND Energy Management System (EMS), connect (by others) as shown in the diagram. The EMS, control relay, shutdown and run lights are furnished by others. When the N.O. contacts close, between terminals [35] and [36] on field wiring terminal block TB2 in the Graphic Control Center, this indicates that the unit is operating; the remote Run Light will be energized. The unit run contacts open when the unit is shutdown (safety or cycling) and the remote indicator will then be energized. For run contacts to EMS only refer to Fig. 4. When terminals [35] and [36] are not used for an EMS, they may be connected to a remote Run Light. The control relay scheme shown in Fig. 23 can also be applied for a remote Run Light AND a Remote Shutdown Indicator, when an EMS is not used.

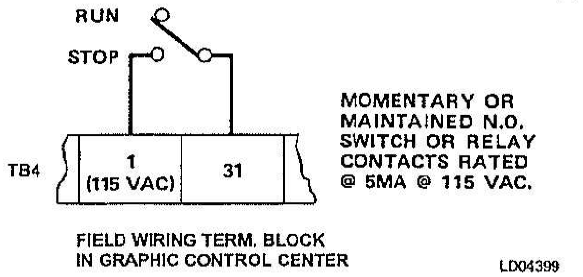

FIG. 24 – AUXILIARY SAFETY SHUTDOWN INPUT

The closure of a Momentary or Maintained N.O. Switch or Relay Contacts will cause the unit to shut down and display: "SAFETY SHUTDOWN – MANUAL RESTART" and "AUXILIARY SAFETY – CONTACTS CLOSED". The unit will not restart until the contacts open and the keypad COMPRESSOR switch is moved to the "STOP-RESET" position ("**O**") and then to the "START" (" ◀ ")position.

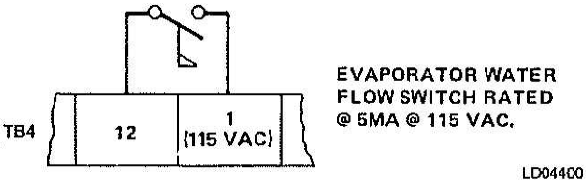

FIG. 25 – EVAPORATOR WATER PUMP INTERLOCK OR FLOW SWITCH

When Evaporator Water is flowing, the flow switch contact will close. If the flow switch opens for 2 seconds, the unit shuts down and displays "CYCLING SHUTDOWN – AUTO RESTART" and "LEAVING CHILLED LIQUID – FLOW SWITCH OPEN". The chiller will automatically restart when the switch again closes. The flow switch status is checked 25 seconds into "START SEQUENCE INITIATED" and continuously thereafter.

NOTES

1. This drawing shows recommended field control wiring modifications (by others) to the standard Graphic Control Center Wiring Diagram. Refer to Graphic Control Center Wiring Diagram: Product Drawing Form 160.54-PW4, units having an Electro-mechanical Starter; Product Drawing Form 160.54-PW5, units furnished with a YORK Solid State Starter; or 160.54-PW6, units with a Variable Speed Drive.
2. If more than one of these modifications is to be utilized with a particular unit, additional consideration must be given to the application to insure proper functioning of the control system. Consult your YORK representative.
3. The additional controls and wiring for these modifications are to be furnished and installed in the field (by others). (See Warning on page 2.)
4. The controls specified are recommended for use, but other controls of equal specifications are acceptable.
5. All wiring shall be in accordance with the National Electrical Code, and applicable State and Local Codes.
6. Each 115VAC field connected inductive load, i.e. relay coil, motor starter coil, etc., shall have a transient suppressor wired (by others) in parallel with its coil, physically located at the coil. Spare transient suppressors are furnished in a bag in the Graphic Control Center.
7. The Graphic Control Center is factory furnished for Manual Restart After Power Failure as a standard function. The control center can be field changed from Manual restart to Auto Restart after a power failure by setting position 5 of Dip Switch SW1 to the ON position - See Fig. 21.
8. Two (2) unit controls schemes are suitable for 8° – 12°F water range. Constant chilled water flow is assumed at all loads. For other requirements contact your YORK representative.
9. _____
10. Lead selector and cycling control to provide similar lead selection and cycling of lag units for three (3) units is available: Kit No. 366-44684D (see Product Drawing Form 160.00-PA1.1) in NEMA I enclosure. Consult your YORK representative.
11. Sequence control kits (see Fig.9 and Note 10) assume a constant chilled water flow and a constant leaving chilled water temperature to sense the cooling load. Sequence control kits are not designed for variable chilled water flow or with reset of the leaving chilled water temperature – see Figs. 18 to 20 and Note 2.
12. Maximum allowable current draw between circuits [24] and [2] for field installed devices is 2 amp holding and 10 amps inrush – see Graphic Control Center Wiring Diagram Form No. in Note 1.
13. For required field wiring connections of the chilled water pump contacts (terminals [44] and [45] on Graphic Control Center field wiring terminal block TB2) and chilled water flow switch (terminals [1] and [12] on Graphic Control Center field wiring terminal board TB2), see Wiring Diagram – Field Connections: Form 160.54-PW4, units having an Electro-mechanical Starter; Product Drawing Form 160.54-PW5, units furnished with a YORK Solid State Starter; or 160.54-PW6, units with a Variable Speed Drive.

    The chilled water flow switch is a safety control. It must be connected to prevent operation of the chiller whenever chilled water flow is stopped. The use of the chilled water flow switch for purposes other than protection of the chiller may be accomplished in several ways. Two flow switches, a flow switch and a relay or separate contacts on the same flow switch.
14. _____
15. Do not apply voltage on field wiring terminal blocks TB4 and TB6 in YORK Graphic Control Center, as 115VAC source is fed from terminals [1] and [2].

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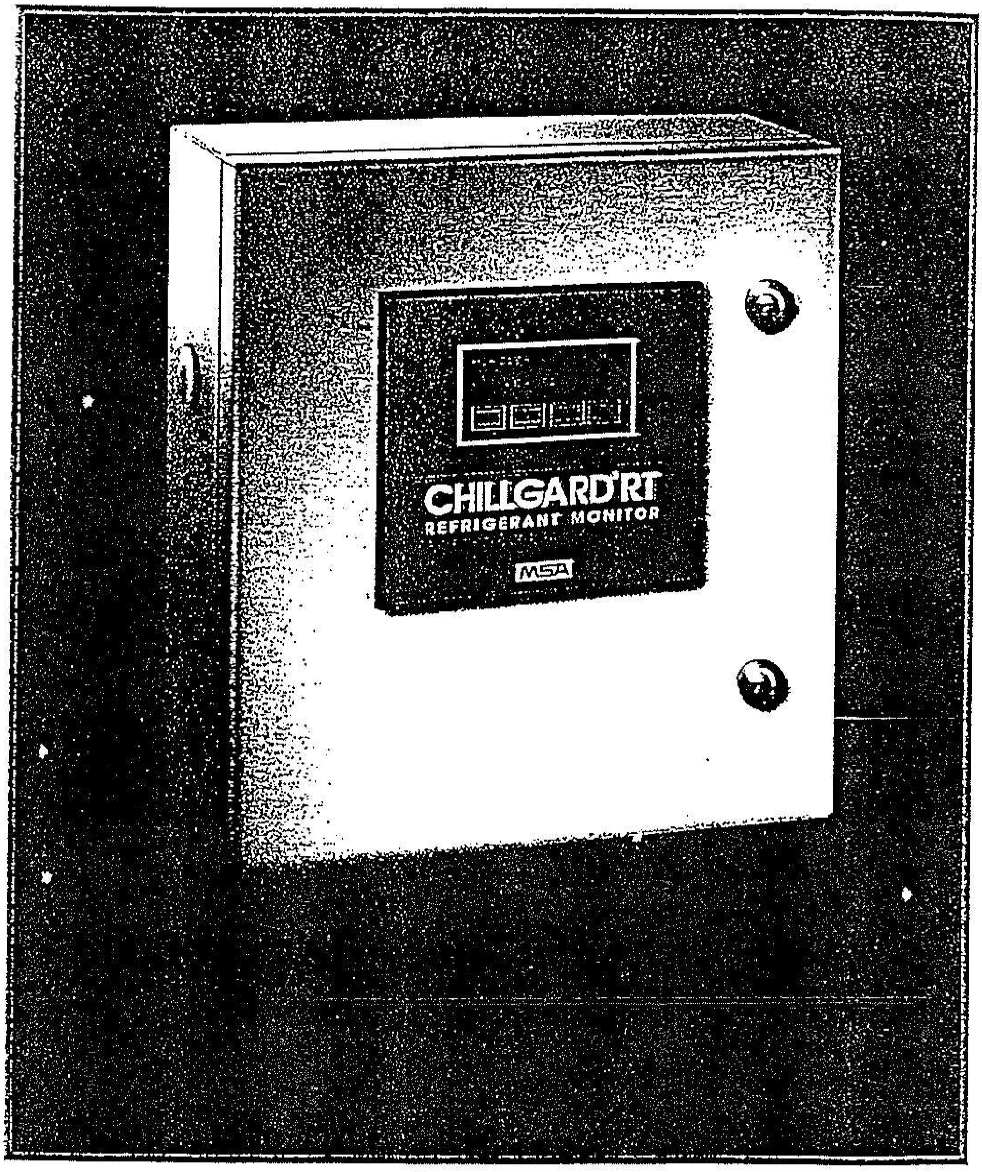

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The next generation of refrigerant leak detection monitors.

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SECTION 1

Refrigerant Monitor

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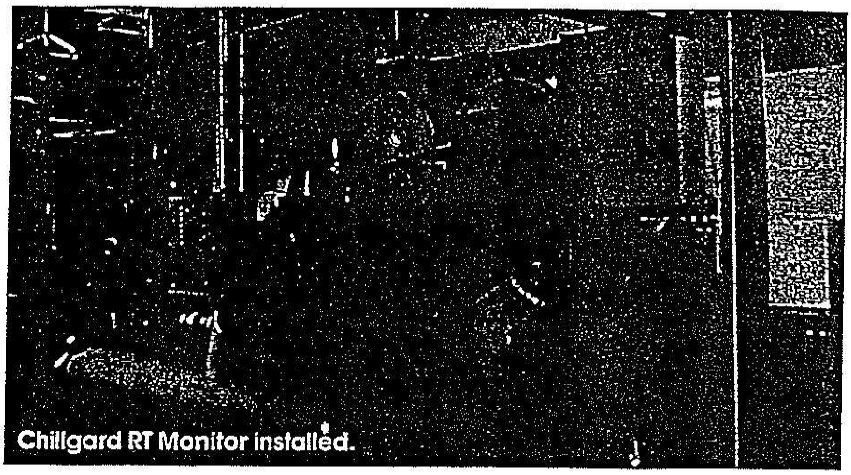
The Chillgard RT Refrigerant Monitor provides economical, low level monitoring of refrigerant gases used in most refrigeration systems or chillers. Some of the refrigerant gases detected by the Chillgard RT Monitor include:

- CFC-11
- CFC-12
- HCFC-22
- Ammonia

as well as the newer refrigerants:

- HCFC-123, and
- HFC-134a.



Chillgard RT Monitor installed.

Many chillers still use the older ozone-depleting refrigerants which are being phased out by the Montreal Protocol, an international agreement. These refrigerants will be in short supply as manufacturing terminates at the end of 1995. This and a Federally-imposed excise tax will drive up the replacement cost, making it essential to detect leaks as low as 1 ppm. Without the capability to monitor down to this low level, leaking refrigerant gases can go undetected for long periods of time.

Replacement cost of refrigerant gas is expensive. The Chillgard RT Monitor saves operating costs by detecting a leak early enough to prevent a major loss of refrigerant gas. In addition, some replacement refrigerants have a threshhold-limit value (TLV) lower than their predecessors. The TLV determines the amount of refrigerant gas a worker can be exposed to while in the machinery room.

Because of these factors, monitoring for refrigerant gases is now a necessity. Also, ANSI/ASHRAE 15-1994 now requires machinery room leak detectors.

Sensor Technology

Only the Chillgard RT Monitor utilizes very stable and highly selective photoacoustic infrared (IR) technology to sense refrigerant gases at levels as low as 1 part-per-million.

The Chillgard RT Monitor can operate for months with virtually no zero drift. Its inherent stability eliminates the requirement of various auto-zeroing techniques which take the monitor "off-line" at regular intervals, leaving the area unprotected. This technique also presents the danger of zeroing on a "contaminated" fresh air source or on low levels of leaking refrigerant, rendering the monitor ineffective for detecting an alarm condition.

Installation of a "fresh air" sampling line or "on-line" scrubber is not required with the Chillgard RT Monitor. These add additional expense to the installation and require routine maintenance to ensure proper operation.

The Chillgard RT Monitor has a high immunity to interferants commonly found in machinery rooms such as cleaning agents and solvents. There is also no effect due to changes in humidity, a common problem with all other sensor technologies. Both are typical sources of false alarms when other sensing technologies are in use.

UL-Approved

The Chillgard RT Refrigerant Monitor has been approved to UL Standard 2075. This assures not only protection from fire and shock hazards but also certifies performance of the instrument to the specifications listed.

Features

- Detectability down to 1 ppm
- Easy to install, operate and maintain
- Operates over a wide temperature range
- Complies with ANSI/ASHRAE 15-1994
- 2 line x 20 character vacuum fluorescent display which shows alarm indications and actual gas concentration
- Three alarm levels
- Relay outputs for each alarm level
- Can be expanded with the Multipoint Sequencer to monitor eight locations.

Applications

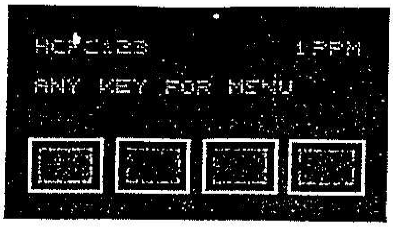
Common refrigerant gases used in industries can also be monitored. These include:

- Propellant filling operations
- Solvent cleaning stations
- Cold storage and transport facilities
- Meat packing plants
- Supermarkets and refrigerant storage locations.

Expandability

Simply by adding the Multipoint Sequencer, the Chillgard RT Refrigerant Monitor can be expanded to monitor up to eight locations. The Multipoint Sequencer is mounted internally to the monitor and can be factory or field installed. The results are:

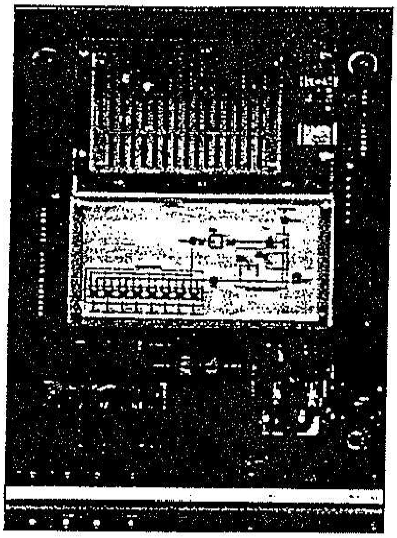
- Refrigerant gas monitoring is now more cost effective, especially when monitoring large areas or multiple locations or chillers



The new Chillgard RT front panel offers a 4-button touchpad and a bright, easy-to-read vacuum fluorescent display.

- The fastest possible response to any leak or spill is obtained
- Fresh sample is pumped from these locations up to 150-foot for each sample.

Simplicity



Chillgard RT Refrigerant Monitor Interior with Multipoint Sequencer.

The Chillgard RT Monitor and its Multipoint Sequencer is easy to install and operate. Four (4) front-panel keys configure the entire system.

The front panel displays all alarm and trouble messages. If a trouble condition occurs, the message is clearly shown on the display and it indicates the *type* of trouble.

The display also indicates the monitored location and the corresponding gas concentration.

Upgradeability

When your chiller is converted to one of the newer refrigerants, your MSA Chillgard RT Monitor can also be converted. Simply contact MSA. The conversion cost is a fraction of the cost of a new system.

Typical Chillgard RT Refrigerant Monitor Installation

Proper operation of the Chillgard RT Refrigerant Monitor depends on proper installation. The following guidelines will aid you in your Chillgard RT Monitor installation:

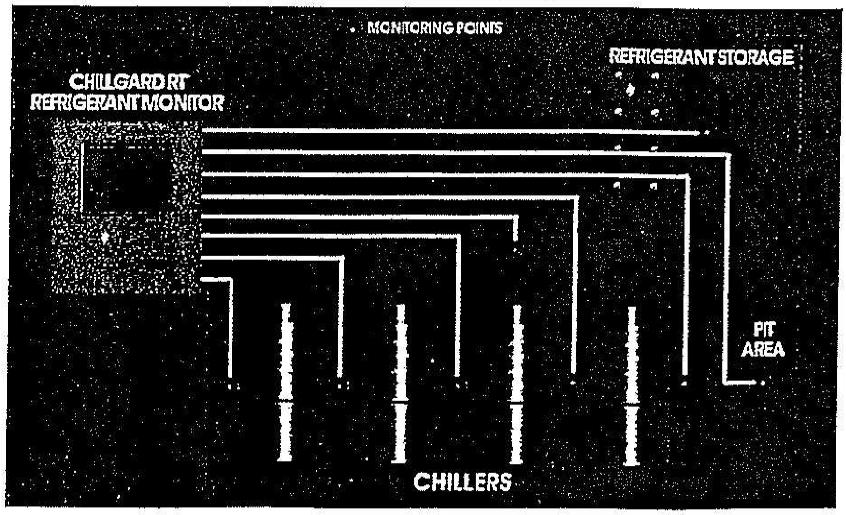
- Place the end of the sample line in the location most likely to develop a refrigerant gas leak or spill. Such areas include valves, fittings and the chiller itself. Also, monitor any refrigerant storage location. It is good practice to keep all sampling lines as short as possible.
- Since most refrigerant gases are heavier than air, monitor these gases close to the floor. Any pits, stairwells or trenches are likely to fill with refrigerant gas before the main area. It may be necessary to monitor these locations for refrigerant gas.
- If ventilation exists in the chiller room, MSA smoke tubes (P/N 458481) will help to determine the most appropriate gas monitoring location.
- The Chillgard RT Refrigerant Monitor can be placed just outside the doorway of the monitored area. The personnel can check the status of the instrument before entering the area.
- Ensure the area is sufficiently monitored. The Chillgard RT Multipoint Sequencer expands the monitoring capability of the instrument up to eight locations.

Specifications

Performance, Chillgard RT

Accuracy:	0-100 ppm ±1 ppm; 100-1000 ppm ±10% reading
Linearity:	0-100 ppm linear, 100-1000 ± 2% of full scale
Sensitivity:	1 ppm
Resolution:	1 ppm
Reproducibility:	±1 ppm over 12 months at specified operating conditions
Response:	90% of a step change in 70 seconds
Operating temperature:	0-50°C, 32-122 °F
Temperature effect:	± 0.3% per °C of reading
Relative humidity:	0-99% non-condensing, no effect on reading
Sample flow rate:	1 liter/minute peak
Maximum total tubing length:	150 feet

Typical Chillgard RT Refrigerant Monitor Installation.



Chillgard® RT Refrigerant Monitor

Operating

Power requirements: .....120 VAC ±10% at 0.56 Amps, or 240 VAC ±10% at 0.3 Amps
Alarm relays: ..... 3 relays @ 8 Amps resistive
Analog output:..... 0-10V, and 4-20mA isolated sourcing
Maximum signal load: ..... 0-10V into 2 kOhms, or 4-20mA into 1 kOhms
Sample tubing connections: .....1/4" OD, 1/8" ID
Flow switch: ..... Activates at flow < 0.5 liter/minute

Performance, Multipoint Sequencer

Maximum Sampled Points: ..... Eight (8)
Maximum Sample Tubing Length: ..... 150 Ft. ea. (1/4" OD, 1/8" ID Tube)

Physical

Enclosure Type: ..... Designed as NEMA 4
Dimensions: ..... 18" high x 16" wide x 7" deep
Weight: ..... 44 lb.

Accessories

Remote Relay Module

The Chillgard RT Remote Relay Module provides discrete relay outputs on a per channel basis when the Multipoint Sequencer is in use. Eight (8), sixteen (16), or twenty-four (24) relays can be utilized to provide a relay output for either Caution, Warning, Alarm, or all of these conditions. These relay outputs are commonly used to activate horns, strobes, or ventilation equipment for separate areas that are monitored by the Chillgard RT Multipoint Sequencer.

Remote Relay Module

Since the Remote Relay Module communicates with the Chillgard RT over a RS-485 serial link it can operate remotely from the Chillgard RT. This allows the Chillgard RT to be installed in the best possible location to keep the sampling lines as short as possible but still provide alarm conditions that can be annunciated at a location of the users choice.

Specifications

Communication - RS-485
Wiring - Twisted-Pair Shielded
Audible Alert - Pizo electric 75 db@5 feet

Operating

Power requirements - 120 VAC ±10% at 240 Watts, or 240 VAC ±10% at 120 Watts
Relays - 4A@120/240 VAC
Operating Temperature - 0-50°C, 32-122°F

Physical

Enclosure Type - Designed for Nema 4
Dimensions - 12.5"(317.5mm)W x 15"(381mm) H x 6.5"(165mm)D
Weight - 25 lb.(.453 kg.)

Ordering Codes

RT - A - [D] — [1] — [B]

Revision code

A	HCFC 123
B	CFC 11
C	HCFC 22
D	HFC 134A
E	CFC 12
F	CFC 113
G	CFC 114
H	Refrigerant 500
I	Refrigerant 502
J	Ammonia
K	Other Refrig.*

1	Single point
4	Four points
8	Eight points

N	No alarm horn & beacon
A	Alarm horn
B	Alarm horn & beacon

*Call for availability.

UL LISTED

Represented by:

Note: This Data Sheet contains only a general description of the MSA Chillgard RT Refrigerant Monitor and Accessories. While uses and performance capabilities are described, under no circumstances should the product be used except by qualified, trained personnel, and not until the instructions, labels or other literature accompanying the product have been carefully read and understood and the precautions therein set forth followed. Only they contain the complete and detailed information concerning this product.

MSA
In U.S, 1-800-MSA-INST or FAX (412) 776-3280
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Elsewhere, MSA International, (412) 967-3228 or FAX (412) 967-3373

Instrument Division P.O. Box 427, Pittsburgh, PA 15230 U.S.A.

http://www.MSAnet.com

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GAS MONITOR SPECIFICATION FOR THE CHILLGARD RT REFRIGERANT MONITOR

1.0 Gas Monitor Specification - Paragraphs 1.1 through 1.13 details the specification for the Gas Monitoring System.

1.1 General - The gas monitoring system shall continuously measure and display the specified gas concentration. The system shall provide visual indicators when preset limits are exceeded. Relay output for alarms and control shall be provided.

1.2 Number and Types of Monitoring Points - The number and type of monitors shall be as follows:

GAS	RANGE/FULL SCALE	NUMBER OF POINTS
HCFC-123	0-1000 ppm	_____
HFC-134A	0-1000 ppm	_____
CFC-11	0-1000 ppm	_____
CFC-12	0-1000 ppm	_____
CFC-22	0-1000 ppm	_____
_____	_____	_____

1.3 System Configuration - The system design shall conform to Paragraphs 1.3 through 1.9.

1.3.1 Description - The system shall consist of a sample draw monitor/readout unit.

1.3.2 Monitor/Readout Configuration - The unit shall be a wall mount type. It shall conform to Paragraphs 1.3.2.1 through 1.3.2.5.

1.3.2.1 Enclosure Type - The enclosure shall be a NEMA 4 type. Access to the inside of the enclosure and wiring connections shall be through a front facing, full length door. The door shall have a window of sufficient size to allow the viewing of a 2 line x 20 character vacuum fluorescent display.

1.3.2.2 Enclosure Size - The enclosure shall be no more than 18 inches in any dimension (mounting provisions excluded).

1.3.2.3 Mounting Provisions - Mounting brackets for the purpose of attaching the unit to a flat surface shall be provided.

1.3.2.4 External Controls - A four (4) button keypad should provide access to all monitor functions including display, calibration, set-up and diagnostics. The keys shall also provide alarm acknowledgment and audible alarm silencing.

1.3.2.5 Sample Gas Inlet/Outlet - The sample gas inlet/outlet shall be on the bottom of the enclosure. There shall not be any other gas inlet or outlet such as zero or compensation gas inlet.

1.3.3 Operating Principle - The principle of operation shall be of the infrared photo-acoustic absorption type.

1.3.3.1 Analyzer Sample - The analyzer shall be of the sample draw type with an internal pump and filter.

1.3.3.2 Analyzer Sensitivity - The analyzer shall be capable of monitoring over a range of 0-1000 ppm with a sensitivity of 1 ppm in the 0-100 ppm range and ±10% of reading in the 100-1000 ppm range.

1.3.3.3 Analyzer Linearity - The analyzer shall be capable of maintaining a linear response in the range of 0-100 ppm and ± 2% of full scale in the range of 100-1000 ppm.

1.3.3.4 Temperature - The system shall operate over the range of 0° to 50° C.

1.3.3.5 Stability - The 30 day zero or span drift must be less than 1% F.S. without the aid of automatic or manual re-calibration. The system must not employ any type of auto zero techniques in order to maintain analyzer stability. Use of fresh air source or scrubber as a zero reference is not permitted.

1.4 Calibration - The system must provide a menu-driven method of checking both zero and span calibration. Any adjustments must be made through front panel keypad.

1.5 Monitor Unit Requirements

1.5.1 Readout Displays - A 2 line x 20 character vacuum fluorescent display shall be provided for the purpose of displaying the gas concentration, diagnostics, set-up and calibration menu.

1.5.2 Visual Alarm Indicators - All alarm indications shall be displayed on the front panel display.

1.5.3 Alarm Set Point Levels - Three separate alarm set point levels shall be provided. The set points shall be independently adjustable for any value for a given range. The set points shall provide drive signals to user interface relays. The alarm set points shall have the capability of providing the user a selection of latching or non-latching.

1.5.4 Relay Outputs - The alarm set point drive signals shall activate user relays as specified in Paragraphs 1.5.4.1 through 1.5.4.3.

1.5.4.1 Number of Relays - As a minimum, one relay for each alarm set point level shall be provided.

1.5.4.2 Contact Rating - All relays shall be Form C, single pole, double throw. Dry contacts shall be rated for 8 amps resistive at 120 VAC.

1.5.4.3 Contact Selection - The contacts shall be capable of being selected normally energized or non-energized, latching or non-latching.

1.5.5 Malfunction Indication - The readout display described in Paragraph 1.4.1 shall display full diagnostics when a fault exists without the use of codes.

1.5.6 Audible Alarm - An audible buzzer is included, it sounds when one of the three preselected alarm conditions or a trouble condition occurs.

1.5.7 Front Panel Controls - The function listed in this paragraph shall be accomplished using a keypad readily accessible on the front panel.

No tool or special adapters shall be used for:
a. display of alarm set point level on the readout display
b. resetting any alarm set point
c. zero and span calibration adjustments

1.5.8 Sample Gas Filter - There shall be an internal sample gas filter. This filter shall be easily serviced or replaced.

1.5.9 Output Signals - The system shall be capable of supplying a 4-20 mA isolated sourcing signal and 0-10 VDC, signal representing the gas concentration being sampled.

1.6 System Power Requirements - The system shall operate on 115 or 220 VAC. Power input not to exceed 60 watts in single channel of operation.

1.7 Multi Point Capability - The system shall be expandable to include a Multi Point Sequencer with up to four (4) sampling points.

1.7.1 System must be capable of allowing the user, through the front panel keypad, to determine which of the four (4) points are to be active in the sequencer.

1.7.2 The sequencer shall be mounted integral to the analyzer.

1.8 Sequencer Programming Limits - The sequencer system parameters shall be within the following limits:

a. Point Dwell Time = 30 seconds
b. Alarm Levels = 3 to 1000 part per million in one part per million increments.

1.8.1 Sample Tubing Connection - Fittings suitable for the connection of 1/4" O.D. tubing shall be provided on the bottom of the enclosure for the purposes of connection, sample lines, calibration gases and exhaust.

1.8.2 Alarm - Three alarm set point levels shall be provided for each sample location. Any alarm set point shall be capable of activating one relay (SPDT, 8 amp at 120 VAC, resistive).

1.8.3 Indicating Lights - All indications related to the Multi Point Sequencer shall appear on the front panel display.

1.9 Sample Handling - The sample handling system shall conform to Paragraphs 1.9.1 through 1.9.4.

1.9.1 Sample Line Compatibility - The system shall be capable of drawing a sample through 1/8" I.D. tubing for a distance of 150 feet.

1.9.2 Sequencer Operation - A sample shall be drawn from the next line in sequence regardless of which location is being analyzed.

1.9.3 Sample Conditioning - The system shall provide adequate filtration of the sample suitable to protect the analyzer.

1.9.4 Exhaust - Exhaust fitting shall be provided on the bottom of the enclosure for the purpose of attaching exhaust lines to the sample and bypass flows.

1.10 Maximum System Maintenance Requirements - The system shall require no periodic maintenance other than periodic checking. Periodic checking or adjustments of the unit shall be capable of being accomplished by one person at the unit location.

1.11 Manufacturer Capability Requirements - As a minimum, the Gas Monitoring Equipment manufacturer must meet the following requirements:

a. be capable of supplying all equipment used to check or calibrate the unit
b. be capable of providing on site service with factory trained personnel
c. be capable of providing start-up assistance and training for the owner/operator

1.12 Gas Monitoring System shall be a Mine Safety Appliances Company Chillgard RT Refrigerant Monitor or equal.

1.13 The Gas Monitoring System shall be tested, approved, and certified by UL to the standards of UL 2075, including performance testing, and shall be listed and labeled accordingly.

ITEMS PROVIDED BY YORK

CHILLGUARD RT - WILL BE SINGLE POINT

BEACON - HORN - QTY. OF (1) WILL BE PROVIDED

CALIBRATION KIT - LESS GAS WILL BE PROVIDED. QTY OF (1).

YORK INTERNATIONAL CORPORATION

Philadelphia Applied Systems
75 Great Valley Parkway
Malvern, PA 19355
800-528-YORK

SECTION 1

Installation Instructions

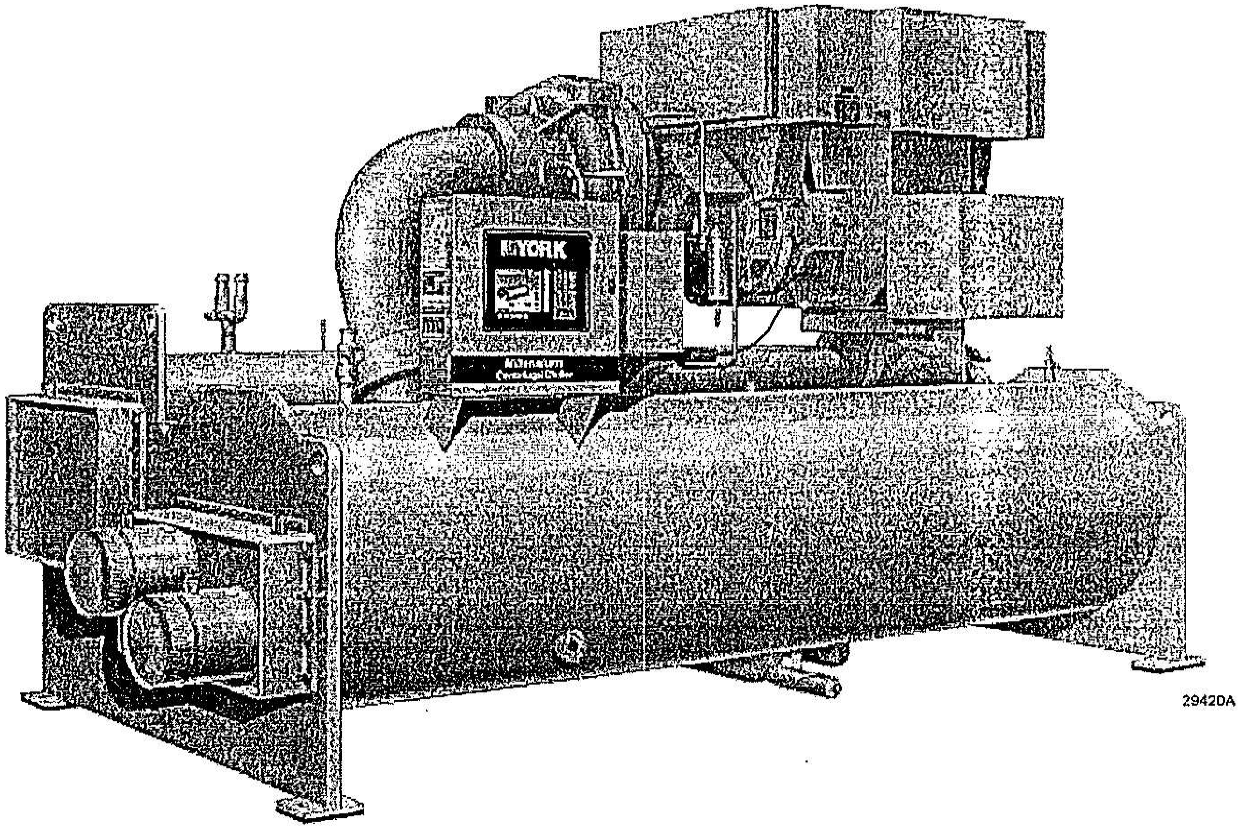
Engineering Guide

DEL CASTLE CHILLER

YORK®	*MILLENNIUM*™ CENTRIFUGAL LIQUID CHILLERS	
INSTALLATION INSTRUCTIONS	Supersedes: Nothing	Form 160.54-N1 (399)

MODEL YK (STYLE E)
R-134a (COOLING ONLY)

WITH GRAPHIC CONTROL CENTER FOR ELECTRO-MECHANICAL STARTER, SOLID STATE STARTER & VARIABLE SPEED DRIVE



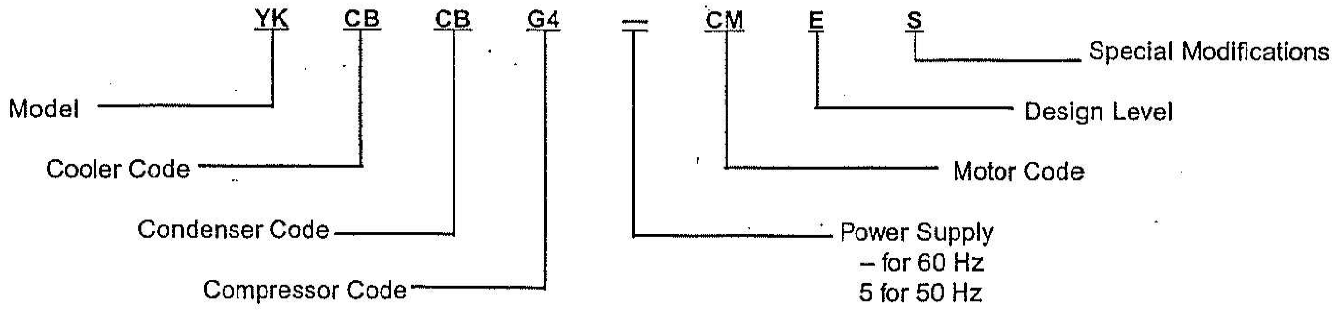
2942DA

Metric Conversions

ALLOWABLE COMPRESSOR/ COOLER/CONDENSER/MOTOR COMBINATIONS

COMPRESSOR CODE	COOLER CODE	CONDENSER CODE	MOTOR CODES	
			60 HZ	50 HZ
G4	CB, CC, CD, CE	CB, CC, CD, DB, DC, DD	CH – CT	5CE – 5CS
	DD, DE	CB, CC, CD, DB, DC, DD, EB, EC, ED		
H0/H4	DB, DC, DD	DB, DC, DD, EB, EC, ED	CH – CV	5CE – 5CX
	EC, ED	DB, DC, DD, EB, EC, ED, FB, FC, FD		
	FC, FD	EB, EC, ED, FB, FC, FD		
H1/H5	EB	EB, EC, ED, FB, FC, FD	CN – CY	5CK – 5DD
	FB, FC, FD	EB, EC, ED, FB, FC, FD, GB, GC, GD		
	GC, GD	FB, FC, FD, GB ,GC, GD		
H2/H6	FB, FC	FA, FB, FC, FD, GB, GC, GD	CN – CZ	5CK – 5DD
	GB, GC, GD	FA, FB, FC, FD, GB, GC, GD		
	HB, HC	GB, GC, GD		
H3/H8	GB, GC, GD	FB, FC, FD, GB, GC, GD	CN – CZ (H8) CN-CB (H3)	5CK – 5CU (H8) 5CK – 5CX (H3)
	HB, HC	GB, GC, GD		
J1 J2	GF, GH	GB, GC, GD, HB, HC, HD	CW – DH	5CS – 5DH
	HF, HH	GB, GC, GD, HB, HC, HD, JB, JC, JD		
	JF, JG, JH	HB, HC, HD, JB, JC, JD		
	TF, TG, TH	TB, TC, TD		
J3	HF, HH	HB, HC, HD, JB, JC, JD	DA – DJ	5DA – 5DH
	JF, JG, JH	HB, HC, HD, JB, JC, JD		
	TF, TG, TH	TB, TC, TD, VB, VC, VD	DA – DJ	5DA – 5DH
	VF, VH	TB, TC, TD, VB, VC, VD		
	WF, WH	VB, VC, VD		
J4	JF, JG, JH	JB, JC, JD	DA – DJ	5DA – 5DH
	TF, TG, TH	TB, TC, TD, VB, VC, VD	DA – DJ	5DA - 5OJ
	VF, VH	TB, TC, TD, VB, VC, VD		
	WF, WH	VB, VC, VD		

NOMENCLATURE



IMPORTANT!

READ BEFORE PROCEEDING!

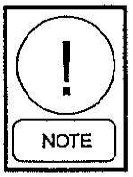
GENERAL SAFETY GUIDELINES

This equipment is a relatively complicated apparatus. During installation, operation maintenance or service, individuals may be exposed to certain components or conditions including, but not limited to: refrigerants, oils, materials under pressure, rotating components, and both high and low voltage. Each of these items has the potential, if misused or handled improperly, to cause bodily injury or death. It is the obligation and responsibility of operating/service personnel to identify and recognize these inherent hazards, protect themselves, and proceed safely in completing their tasks. Failure to comply with any of these requirements could result in serious damage to the equipment and the property in which it is situated, as well as severe personal injury or death to themselves and people at the site.

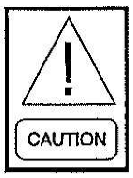
This document is intended for use by owner-authorized operating/service personnel. It is expected that this individual posseses independent training that will enable them to perform their assigned tasks properly and safely. It is essential that, prior to performing any task on this equipment, this individual shall have read and understood this document and any referenced materials. This individual shall also be familiar with and comply with all applicable governmental standards and regulations pertaining to the task in question.

SAFETY SYMBOLS

The following symbol is used in this document to alert the reader to areas of potential hazard:



NOTE is used to highlight additional information which may be helpful to you.



CAUTION identifies a hazard which could lead to damage to the machine, damage to other equipment and/or environmental pollution. Usually an instruction will be given, together with a brief explanation.

CHANGEABILITY OF THIS DOCUMENT

In complying with YORK's policy for continuous product improvement, the information contained in this document is subject to change without notice. While YORK makes no commitment to update or provide current information automatically to the manual owner, that information, if applicable, can be obtained by contacting the nearest YORK Applied Systems Service office.

It is the responsibility of operating/service personnel to verify the applicability of these documents to the equipment in question. If there is any question in the mind of operating/service personnel as to the applicability of these documents, then prior to working on the equipment, they should verify with the owner whether the equipment has been modified and if current literature is available.

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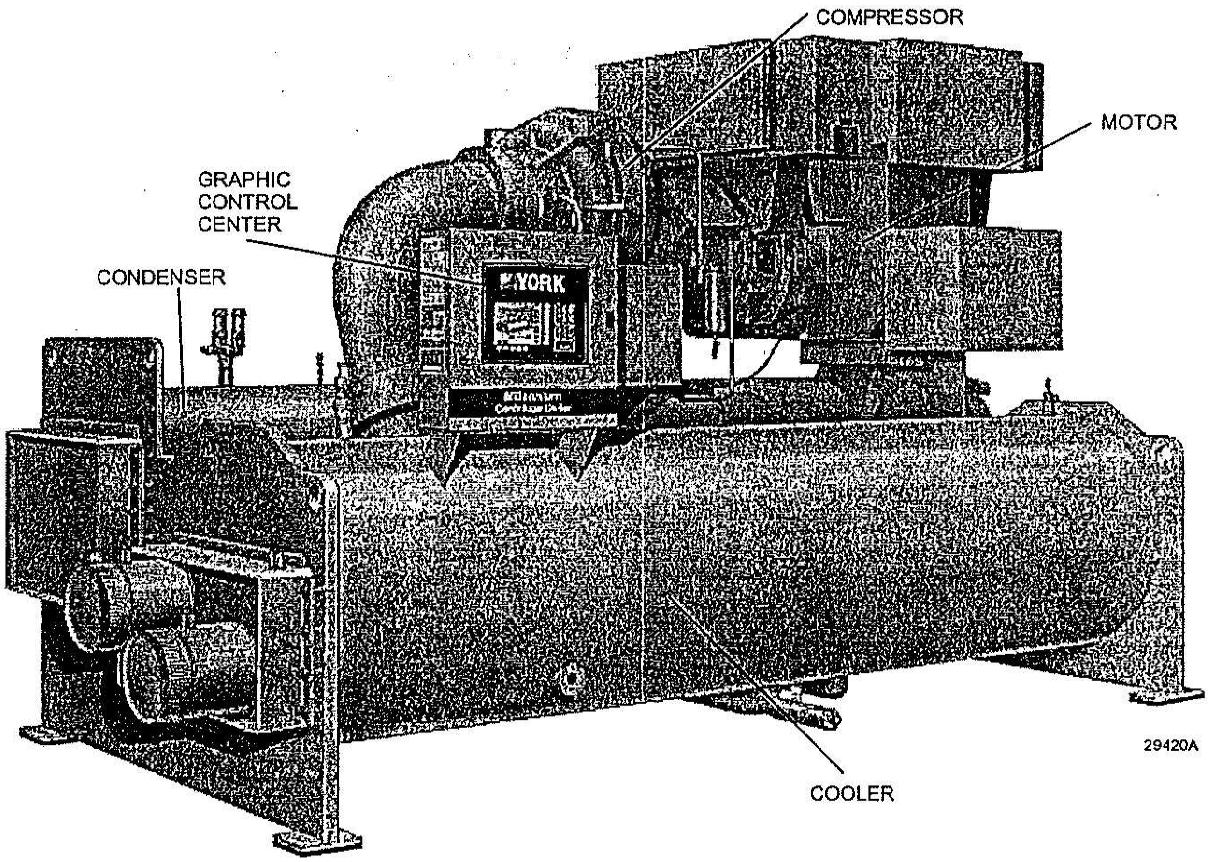
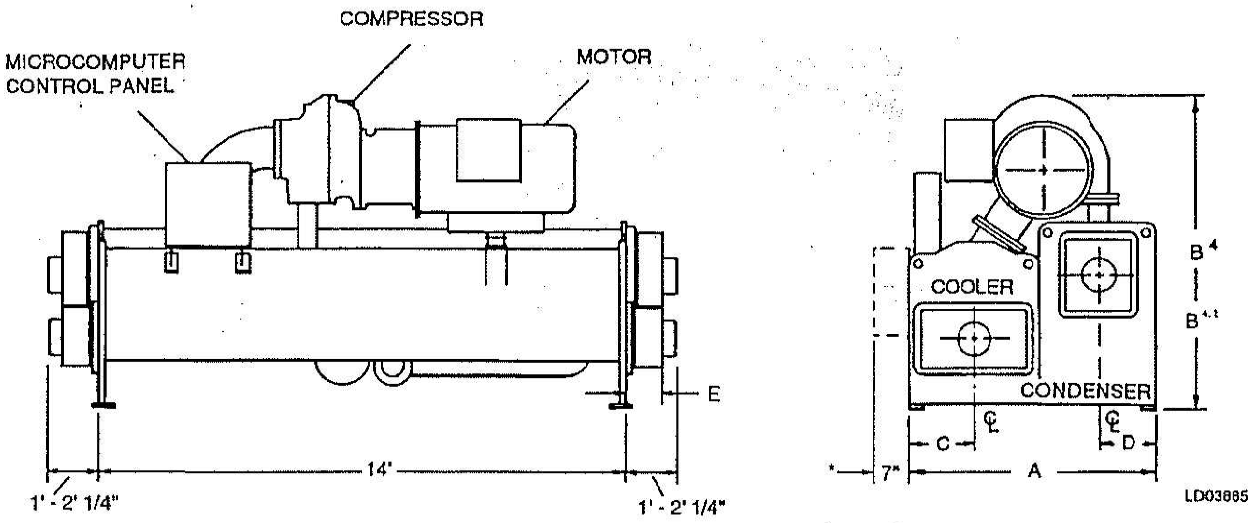


FIG. 1 – MODEL YK MILLENNIUM CHILLER



* Operating Location of Control Center on Cooler Codes G thru W.

G4 COMPRESSORS
COOLER – CONDENSER SHELL CODES

	C–C	C–D	D–C	D–D	D–E
A	6'–1"	6'–1"	6'–4"	6'–4"	6'–4"
B	7'–10-1/2"	8'–0-1/2"	7'–10-1/2"	8'–0-1/2"	8'–1"
C	1'–7"	1'–7"	1'–8-1/2"	1'–8-1/2"	1'–8-1/2"
D	1'–5-1/2"	1'–5-1/2"	1'–5-1/2"	1'–5-1/2"	1'–5-1/2"
E	0'–5-5/8"	0'–5-5/8"	0'–5-5/8"	0'–5-5/8"	0'–5-5/8"

H0/H4 COMPRESSORS
COOLER – CONDENSER SHELL CODES

	D–D	D–E	E–D	E–E	E–F	F–E	F–F
A	6'–4"	6'–4"	6'–6"	6'–6"	6'–9"	6'–11"	7'–2"
B	8'–0-1/2"	8'–1"	8'–0-1/2"	8'–1"	8'–3-1/2"	8'–1"	8'–3-1/2"
C	1'–8-1/2"	1'–8-1/2"	1'–9-1/2"	1'–9-1/2"	1'–9-1/2"	2'–0"	2'–0"
D	1'–5-1/2"	1'–5-1/2"	1'–5-1/2"	1'–5-1/2"	1'–7"	1'–5-1/2"	1'–7"
E	0'–5-5/8"	0'–5-5/8"	0'–5-7/8"	0'–5-7/8"	0'–5-7/8"	0'–5-7/8"	0'–5-7/8"

H1/H5 COMPRESSORS
COOLER – CONDENSER SHELL CODES

	E–E	E–F	F–E	F–F	F–G	G–F	G–G
A	6'–6"	6'–9"	6'–11"	7'–2"	7'–6"	7'–4-1/2"	7'–8-1/2"
B	8'–1"	8'–3-1/2"	8'–1"	8'–3-1/2"	8'–7-1/2"	8'–3-1/2"	8'–7-1/2"
C	1'–9-1/2"	1'–9-1/2"	2'–0"	2'–0"	2'–0"	2'–1-1/4"	2'–1-1/4"
D	1'–5-1/2"	1'–7"	1'–5-1/2"	1'–7"	1'–9"	1'–7"	1'–9"
E	0'–5-7/8"	0'–5-7/8"	0'–5-7/8"	0'–5-7/8"	0'–5-7/8"	0'–6-1/4"	0'–6-1/4"

H2/H6 COMPRESSORS
COOLER – CONDENSER SHELL CODES

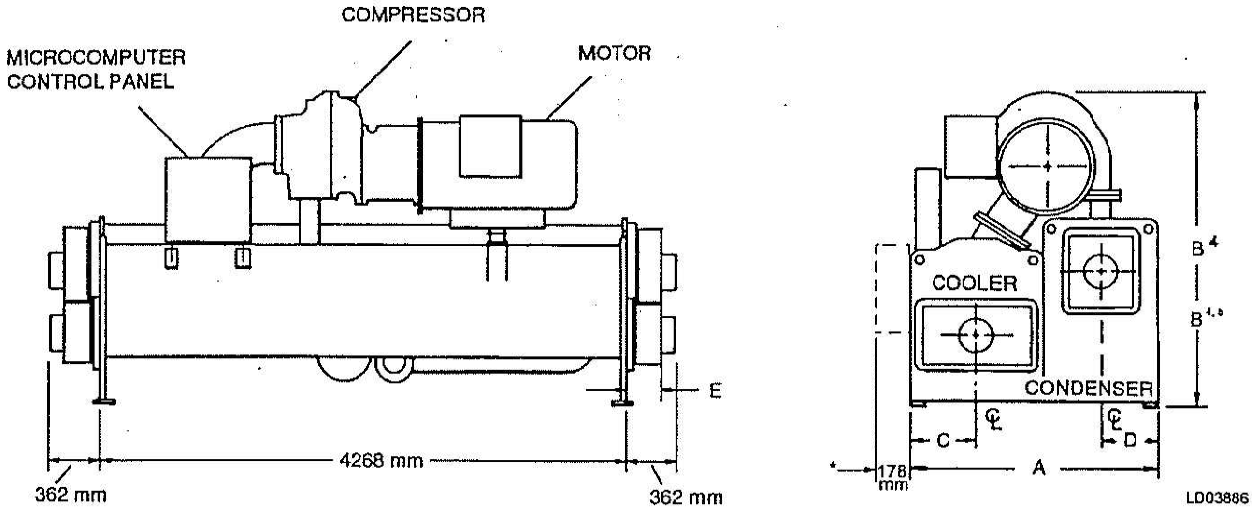
	F–F	F–G	G–F	G–G	H–G
A	7'–2"	7'–6"	7'–4-1/2"	7'–8-1/2"	8'–0"
B	8'–6-3/4"	8'–10-1/4"	8'–6-3/4"	8'–10-1/4"	8'–10-1/4"
C	2'–0"	2'–0"	2'–1-1/4"	2'–1-1/4"	2'–3"
D	1'–7"	1'–9"	1'–7"	1'–9"	1'–9"
E	0'–5-7/8"	0'–5-7/8"	0'–6-1/4"	0'–6-1/4"	0'–6-1/4"

H3/H8 COMPRESSORS
COOLER – CONDENSER SHELL CODES

	G–F	G–G	H–G
A	7'–4-1/2"	7'–8-1/2"	8'–0"
B	8'–6-3/4"	8'–10-1/4"	8'–10-1/4"
C	2'–1-1/4"	2'–1-1/4"	2'–3"
D	1'–7"	1'–9"	1'–9"
E	0'–6-1/4"	0'–6-1/4"	0'–6-1/4"

NOTES:
1. All dimensions are approximate. Certified dimensions are available on request.
2. For compact water boxes (shown above), determine overall unit length by adding water box depth to tube sheet length.
3. Water nozzles can be located on either end of unit. Add 1/2" to nozzle length for flanges connections.
4. To determine overall height, add 7/8" for isolators.
5. Use of motors with motor hoods may increase overall unit dimensions.

FIG. 2 – DIMENSIONS – G & H COMPRESSOR UNITS (FT.–IN.)



* Operating Location of Control Center on Cooler Codes G thru W.

G4 COMPRESSORS COOLER – CONDENSER SHELL CODES					
	C–C	C–D	D–C	D–D	D–E
A	1854	1854	1930	1930	1930
B	2400	2451	2400	2451	2464
C	483	483	521	521	521
D	445	445	445	445	445
E	143	143	143	143	143

H0/H4 COMPRESSORS COOLER – CONDENSER SHELL CODES							
	D–D	D–E	E–D	E–E	E–F	F–E	F–F
A	1930	1930	1981	1981	2057	2108	2184
B	2451	2464	2451	2464	2527	2492	2527
C	521	521	546	546	546	610	610
D	445	445	445	445	483	445	483
E	143	143	149	149	149	149	149

H1/H5 COMPRESSORS COOLER – CONDENSER SHELL CODES							
	E–E	E–F	F–E	F–F	F–G	G–F	G–G
A	1981	2057	2108	2184	2286	2248	2350
B	2464	2527	2492	2527	2324	2527	2324
C	546	546	610	610	610	641	641
D	445	483	445	483	533	483	533
E	149	149	149	149	149	159	159

H2/H6 COMPRESSORS COOLER – CONDENSER SHELL CODES					
	F–F	F–G	G–F	G–G	H–G
A	2184	2286	2248	2350	2438
B	2527	2324	2527	2324	2691
C	610	610	641	641	686
D	483	533	483	533	533
E	149	149	159	159	159

H3/H8 COMPRESSORS COOLER – CONDENSER SHELL CODES			
	G–F	G–G	H–G
A	2248	2350	2438
B	2527	2324	2691
C	641	641	686
D	483	533	533
E	159	159	159

NOTES:
1. All dimensions are approximate. Certified dimensions are available on request.
2. For compact water boxes (shown above), determine overall unit length by adding water box depth to tube sheet length.
3. Water nozzles can be located on either end of unit. Add 13 mm to nozzle length for flanges connections.
4. To determine overall height, add 22 mm for isolators.
5. Use of motors with motor hoods may increase overall unit dimensions.

FIG. 3 – DIMENSIONS – G & H COMPRESSOR UNITS (mm)

FIG. 6 – UNIT WEIGHTS LESS MOTOR (G & H COMPRESSORS)

SHELLS		SHIPPING WEIGHT		OPERATING WEIGHT		REFRIGERANT CHARGE		LOADING PER ISOLATOR	
		(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)
C-C	CBCB	16670	7580	20000	9090	1350	612	5000	2273
	CBCC	16730	7600	20100	9140	1350	612	5025	2285
	CBCD	16870	7670	20200	9180	1350	612	5050	2295
	CCCB	16900	7680	20300	9230	1350	612	5075	2308
	CCCC	16960	7710	20300	9230	1350	612	5075	2308
	CCCD	17100	7770	20500	9320	1350	612	5125	2330
	CDCB	17170	7800	20500	9320	1350	612	5125	2330
	CDCC	17230	7830	20600	9360	1350	612	5150	2340
	CDCD	17370	7900	20700	9410	1350	612	5175	2353
	CECB	17430	7920	20800	9450	1350	612	5200	2363
	CECC	17490	7950	20900	9500	1350	612	5225	2375
	CECD	17630	8010	21000	9550	1350	612	5250	2388
C-D	CBDB	17060	7750	20400	9270	1400	635	5100	2318
	CBDC	17070	7760	20400	9270	1400	635	5100	2318
	CBDD	17360	7890	20700	9410	1400	635	5175	2353
	CCDB	17300	7860	20700	9410	1400	635	5175	2353
	CCDC	17310	7870	20700	9410	1400	635	5175	2353
	CCDD	17590	8000	21000	9550	1400	635	5250	2388
	CDDB	17570	7990	20900	9500	1400	635	5225	2375
	CDDC	17580	7990	21000	9550	1400	635	5250	2388
	CDDD	17860	8120	21200	9640	1400	635	5300	2410
	CEDB	17820	8100	21200	9640	1400	635	5300	2410
	CEDC	17830	8100	21200	9640	1400	635	5300	2410
	CEDD	18120	8240	21500	9770	1400	635	5375	2443
D-C	DDCB	17600	8000	21000	9550	1420	644	5250	2388
	DDCC	17660	8030	21000	9550	1420	644	5250	2388
	DDCD	17800	8090	21200	9640	1420	644	5300	2410
	DECB	17750	8070	21100	9590	1420	644	5275	2398
	DECC	17820	8100	21200	9640	1420	644	5300	2410
	DECD	17960	8160	21300	9680	1420	644	5325	2420
D-D	DBDB	17420	7920	20800	9450	1470	667	5200	2363
	DBDC	17430	7920	20800	9450	1470	667	5200	2363
	DBDD	17710	8050	21100	9590	1470	667	5275	2398
	DCDB	17660	8030	21000	9550	1470	667	5250	2388
	DCDC	17670	8030	21000	9550	1470	667	5250	2388
	DCDD	17960	8160	21300	9680	1470	667	5325	2420
	DDDB	17990	8180	21400	9730	1470	667	5350	2433
	DDDC	18000	8180	21400	9730	1470	667	5350	2433
	DDDD	18290	8310	21700	9860	1470	667	5425	2465
	DEDB	18150	8250	21500	9770	1470	667	5375	2443
	DEDC	18160	8250	21500	9770	1470	667	5375	2443
	DEDD	18450	8390	21800	9910	1470	667	5450	2478
D-E	DBEB	18680	8490	22400	10180	1590	721	5600	2545
	DBEC	18890	8590	22700	10320	1590	721	5675	2580
	DBED	19000	8640	22800	10360	1590	721	5700	2590
	DCEB	18920	8600	22700	10320	1590	721	5675	2580
	DCEC	19130	8700	22900	10410	1590	721	5725	2603
	DCED	19240	8750	23000	10450	1590	721	5750	2613
	DDEB	19250	8750	23000	10450	1590	721	5750	2613
	DDEC	19470	8850	23200	10550	1590	721	5800	2638
	DDED	19570	8900	23300	10590	1590	721	5825	2648
	DEEB	19410	8820	23200	10550	1590	721	5800	2638
	DEEC	19620	8920	23400	10640	1590	721	5850	2660
	DEED	19730	8970	23500	10680	1590	721	5875	2670

FIG. 6 – UNIT WEIGHTS LESS MOTOR (G & H COMPRESSORS) (Cont'd)

SHELLS		SHIPPING WEIGHT		OPERATING WEIGHT		REFRIGERANT CHARGE		LOADING PER ISOLATOR	
		(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)
E-D	ECDB	18800	8550	22600	10270	1590	721	5650	2568
	ECDC	18810	8550	22700	10320	1590	721	5675	2580
	ECDD	19100	8680	22900	10410	1590	721	5725	2603
	EDDB	19050	8660	22900	10410	1590	721	5725	2603
	EDDC	19060	8660	22900	10410	1590	721	5725	2603
	EDDD	19350	8800	23200	10550	1590	721	5800	2638
E-E	EBEB	19810	9000	24000	10910	1690	767	6000	2728
	EBEC	20020	9100	24300	11050	1690	767	6075	2763
	EBED	20130	9150	24400	11090	1690	767	6100	2773
	ECEB	20050	9110	24300	11050	1690	767	6075	2763
	ECEC	20260	9210	24500	11140	1690	767	6125	2785
	ECED	20370	9260	24600	11180	1690	767	6150	2795
	EDEB	20300	9230	24500	11140	1690	767	6125	2785
	EDEC	20510	9320	24700	11230	1690	767	6175	2808
	EDED	20620	9370	24900	11320	1690	767	6225	2830
E-F	EBFB	21140	9610	25800	11730	1790	812	6450	2933
	EBFC	21260	9660	25900	11770	1790	812	6475	2943
	EBFD	21440	9750	26100	11860	1790	812	6525	2965
	ECFB	21380	9720	26000	11820	1790	812	6500	2955
	ECFC	21500	9770	26100	11860	1790	812	6525	2965
	ECFD	21680	9850	26300	11950	1790	812	6575	2988
	EDFB	21630	9830	26300	11950	1790	812	6575	2988
	EDFC	21750	9890	26400	12000	1790	812	6600	3000
	EDFD	21930	9970	26600	12090	1790	812	6650	3023
F-E	FCEB	21220	9650	25900	11770	1900	862	6475	2943
	FCEC	21430	9740	26200	11910	1900	862	6550	2978
	FCED	21530	9790	26300	11950	1900	862	6575	2988
	FDEB	21470	9760	26200	11910	1900	862	6550	2978
	FDEC	21680	9850	26400	12000	1900	862	6600	3000
	FDED	21790	9900	26500	12050	1900	862	6625	3013
F-F	FBFA	21550	9800	26900	12230	2020	916	6725	3058
	FBFB	21960	9980	27300	12410	2020	916	6825	3103
	FBFC	22080	10040	27400	12450	2020	916	6850	3113
	FBFD	22260	10120	27600	12550	2020	916	6900	3138
	FCFA	21860	9940	27200	12360	2020	916	6800	3090
	FCFB	22270	10120	27600	12550	2020	916	6900	3138
	FCFC	22400	10180	27800	12640	2020	916	6950	3160
	FCFD	22580	10260	27900	12680	2020	916	6975	3170
	FDFB	22530	10240	27900	12680	2020	916	6975	3170
	FDFC	22650	10300	28000	12730	2020	916	7000	3183
	FDFD	22830	10380	28200	12820	2020	916	7050	3205
F-G	FBGB	24140	10970	29900	13590	2150	975	7475	3398
	FBGC	24550	11160	30300	13770	2150	975	7575	3443
	FBGD	24820	11280	30500	13860	2150	975	7625	3465
	FCGB	24460	11120	30200	13730	2150	975	7550	3433
	FCGC	24870	11300	30600	13910	2150	975	7650	3478
	FCGD	25140	11430	30900	14050	2150	975	7725	3513
	FDGB	24720	11240	30400	13820	2150	975	7600	3455
	FDGC	25130	11420	30800	14000	2150	975	7700	3500
	FDGD	25400	11550	31100	14140	2150	975	7775	3535

FIG. 6 – UNIT WEIGHTS LESS MOTOR (G & H COMPRESSORS) (Cont'd)

SHELLS		SHIPPING WEIGHT		OPERATING WEIGHT		REFRIGERANT CHARGE		LOADING PER ISOLATOR	
		(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)
G-F	GBFA	23660	10750	29200	13270	2290	1039	7300	3318
	GBFB	24070	10940	29600	13450	2290	1039	7400	3363
	GBFC	24190	11000	29700	13500	2290	1039	7425	3375
	GBFD	24370	11080	29900	13590	2290	1039	7475	3398
	GCFA	24020	10920	29600	13450	2290	1039	7400	3363
	GCFB	24430	11100	30000	13640	2290	1039	7500	3410
	GCFC	24550	11160	30100	13680	2290	1039	7525	3420
	GCFD	24740	11250	30300	13770	2290	1039	7575	3443
	GDFA	24510	11140	30100	13680	2290	1039	7525	3420
	GDFB	24920	11330	30500	13860	2290	1039	7625	3465
	GDFC	25050	11390	30600	13910	2290	1039	7650	3478
	GDFD	25230	11470	30800	14000	2290	1039	7700	3500
G-G	GBGB	25970	11800	32500	14770	2415	1095	8125	3693
	GBGC	26380	11990	32900	14950	2415	1095	8225	3738
	GBGD	26640	12110	33200	15090	2415	1095	8300	3773
	GCGB	26330	11970	32900	14950	2415	1095	8225	3738
	GCGC	26740	12150	33300	15140	2415	1095	8325	3785
	GCGD	27010	12280	33600	15270	2415	1095	8400	3818
	GDGB	26830	12200	33400	15180	2415	1095	8350	3795
	GDGC	27240	12380	33800	15360	2415	1095	8450	3840
	GDGD	27500	12500	34100	15500	2415	1095	8525	3875
H-G	HBGB	28150	12800	35100	15950	2625	1191	8775	3988
	HBGC	28560	12980	35500	16140	2625	1191	8875	4035
	HBGD	28820	13100	35700	16230	2625	1191	8925	4058
	HCGB	28770	13080	35700	16230	2625	1191	8925	4058
	HCGC	29180	13260	36100	16410	2625	1191	9025	4103
	HCGD	29450	13390	36400	16550	2625	1191	9100	4138

FIG. 7 – UNIT WEIGHTS LESS MOTOR (J COMPRESSOR UNITS – SEE NOTE ON PAGE 14)

SHELLS		SHIPPING WEIGHT		OPERATING WEIGHT		REFRIGERANT CHARGE		LOADING PER ISOLATOR	
		(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)
G-G	GFGB	25900	11748	32050	14538	2415	1095	8013	3634
	GFGC	26330	11943	32600	14787	2415	1095	8150	3697
	GFGD	26540	12039	32900	14923	2415	1095	8225	3731
	GHGB	26290	11925	32610	14792	2415	1095	8153	3698
	GHGC	26720	12120	33320	15114	2415	1095	8330	3778
	GHGD	26930	12215	33550	15218	2415	1095	8388	3805
G-H	GFHB	27320	12392	33950	15400	2560	1161	8488	3850
	GFHC	27500	12474	34260	15540	2560	1161	8565	3885
	GFHD	27730	12578	34560	15676	2560	1161	8640	3919
	GHHB	27710	12569	34510	15654	2560	1161	8628	3913
	GHHC	27890	12651	34820	15794	2560	1161	8705	3949
	GHHD	28120	12755	36110	16379	2560	1161	9028	4095
H-G	HFGB	28020	12710	34080	15459	2625	1191	8520	3865
	HFGC	28440	12900	35480	16094	2625	1191	8870	4023
	HFGD	28650	12996	35800	16239	2625	1191	8950	4060
	HHGB	28550	12950	35630	16162	2625	1191	8908	4040
	HHGC	28980	13145	36240	16438	2625	1191	9060	4110
	HHGD	29190	13241	36570	16588	2625	1191	9143	4147
H-H	HFHB	29430	13349	36760	16674	2825	1281	9190	4169
	HFHC	29260	13272	37080	16819	2825	1281	9270	4205
	HFHD	29850	13540	37380	16956	2825	1281	9345	4239
	HHHB	29970	13594	37530	17024	2825	1281	9383	4256
	HHHC	30150	13676	37480	17001	2825	1281	9370	4250
	HHHD	30380	13780	38140	17300	2825	1281	9535	4325

FIG. 7 – UNIT WEIGHTS LESS MOTOR (J COMPRESSOR UNITS) (Cont'd) (SEE NOTE ON PAGE 13)

SHELLS		SHIPPING WEIGHT		OPERATING WEIGHT		REFRIGERANT CHARGE		LOADING PER ISOLATOR	
		(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)
H-J	HFJB	31330	14211	39280	17817	3010	1365	9820	4454
	HFJC	31750	14402	39920	18108	3010	1365	9980	4527
	HFJD	31990	14511	40250	18257	3010	1365	10063	4564
	HHJB	31870	14456	40050	18167	3010	1365	10013	4542
	HHJC	32280	14642	40680	18452	3010	1365	10170	4613
	HHJD	32520	14751	41010	18602	3010	1365	10253	4651
J-H	JFHB	32410	14701	40580	18407	3310	1501	10145	4602
	JFHC	32590	14783	40890	18548	3310	1501	10223	4637
	JFHD	32820	14887	41180	18679	3310	1501	10295	4670
	JGHB	32780	14869	41100	18643	3310	1501	10275	4661
	JGHC	32960	14951	41410	18784	3310	1501	10353	4696
	JGHD	33190	15055	41710	18920	3310	1501	10428	4730
	JHHB	33140	15032	41620	18879	3310	1501	10405	4720
	JHHC	33330	15118	41940	19024	3310	1501	10485	4756
	JHHD	33530	15209	42240	19160	3310	1501	10560	4790
J-J	JFJB	34310	15563	43100	19550	3495	1585	10775	4888
	JFJC	34720	15749	43730	19836	3495	1585	10933	4959
	JGJD	34960	15858	44050	19981	3495	1585	11013	4995
	JGJB	34880	15822	43620	19786	3495	1585	10905	4947
	JGJC	35090	15917	44250	20072	3495	1585	11063	5018
	JGJD	35330	16026	44580	20221	3495	1585	11145	5055
	JHJB	35040	15894	44140	20022	3495	1585	11035	5005
	JHJC	35450	16080	44780	20312	3495	1585	11195	5078
	JHJD	35700	16194	45110	20462	3495	1585	11278	5115
T-T	TFTB	37260	16901	47230	21424	3995	1812	11808	5356
	TFTC	37750	17123	47970	21759	3995	1812	11993	5440
	TFTD	38010	17241	48330	21922	3995	1812	12083	5481
	TGTB	37680	17092	47630	21605	3995	1812	11908	5401
	TGTC	38170	17314	48570	22031	3995	1812	12143	5508
	TGTD	38440	17436	48940	22199	3995	1812	12235	5550
	THTB	38110	17287	48440	21972	3995	1812	12110	5493
	THTC	38600	17509	49180	22308	3995	1812	12295	5577
	THTD	38860	17627	49540	22471	3995	1812	12385	5618
	TFVB	41430	18793	52410	23773	4290	1946	13103	5943
	TFVC	41630	18883	52780	23941	4290	1946	13195	5985
	TFVD	42450	19255	53910	24454	4290	1946	13478	6113
T-V	TGVB	41860	18988	53020	24050	4290	1946	13255	6012
	TGVC	42060	19078	53390	24218	4290	1946	13348	6054
	TGVD	42880	19450	54520	24730	4290	1946	13630	6183
	THVB	42280	19178	53620	24322	4290	1946	13405	6081
	THVC	42480	19269	53990	24490	4290	1946	13498	6122
	THVD	43300	19641	56120	25456	4290	1946	14030	6364
V-T	VFTB	39620	17972	50580	22943	3820	1733	12645	5736
	VFTC	40110	18194	51320	23279	3820	1733	12830	5820
	VFTD	40380	18316	51690	23447	3820	1733	12923	5862
	VHTB	40220	18244	51430	23329	3820	1733	12858	5832
	VHTC	40700	18462	52170	23664	3820	1733	13043	5916
	VHTD	40970	18584	52540	23832	3820	1733	13135	5958
V-V	VFVB	42700	19369	54670	24798	4150	1882	13668	6200
	VFVC	42900	19459	55040	24966	4150	1882	13760	6242
	VFVD	43720	19831	56170	25479	4150	1882	14043	6370
	VHVB	43290	19636	55520	25184	4150	1882	13880	6296
	VHVC	43490	19727	55880	25347	4150	1882	13970	6337
	VHVD	44310	20099	57010	25860	4150	1882	14253	6465
W-V	WFVB	46180	20947	59850	27148	4460	2023	14963	6787
	WFVC	46380	21038	60210	27311	4460	2023	15053	6828
	WFVD	47200	21410	61340	27824	4460	2023	15335	6956
	WHVB	47550	21569	61790	28028	4460	2023	15448	7007
	WHVC	47740	21655	62150	28191	4460	2023	15538	7048
	WHVD	48570	22031	63290	28708	4460	2023	15823	7177

FIG. 8 – MOTOR WEIGHTS

LOW VOLTAGE

MOTOR CODE		WEIGHT	WEIGHT
60 HZ	50 HZ	(LBS)	(KGS)
CH	—	940	427
CJ	5CE	940	427
CK	5CF	1440	653
CL	5CG	1440	653
CM	5CH	1700	771
CN	5CI	1700	771
CP	5CJ	1700	771
CR	5CK	1700	771
CS	5CL	2635	1195
CT	5CM	2635	1195
CU	5CN	2635	1195
CV	5CO	2635	1195
CW	5CP	2930	1329
CX	5CQ	2930	1329
CY	5CR	2930	1329
CZ	5CS	2930	1329
CA	5CT	5750	2608
CB	5CU	5750	2608
DA	5CV	5750	2608
DB	5CW	6800	3084
DB	5CX	6800	3084
—	5DA	7300	3311
—	5DB	7300	3311

HIGH VOLTAGE

MOTOR CODE		WEIGHT	WEIGHT
60 HZ	50 HZ	(LBS)	(KGS)
CH	—	2670	1211
CJ	5CE	2670	1211
CK	5CF	3100	1406
CL	5CG	3100	1406
CM	5CH	3100	1406
CN	5CI	3100	1406
CP	5CJ	3700	1678
CR	5CK	3700	1678
CS	5CL	3700	1678
CT	5CM	3700	1678
CU	5CN	3700	1678
CV	5CO	4500	2041
CW	5CP	4500	2041
CX	5CQ	4500	2041
CY	5CR	4500	2041
CZ	5CS	4500	2041
CA	5CT	5800	2630
CB	5CU	5800	2630
—	5CV	5800	2630
DA	5CW	6800	3084
DC	5DA	7050	3198
—	5DB	7300	3311
DD	5DC	7300	3311
DE	5DD	7300	3311
DF	5DE	7500	3402
DH	5DF	7500	3402
DJ	5DG	7900	3583
—	5DH	7900	3583
—	5OJ	14000	6350

NOTE:

WEIGHTS (See Pages 12 & 13). Weights for J Compressor Units (Fig. 7) for Shell Codes G-G through T-T are based on J1/J2 Compressors. Add 1000 lb. (454 kg.) to Shipping Weight and Operating Weight, and 250 lb. (113 kg) to Loading Per Isolator if J3/J4 Compressor is furnished. Weight for Shell Codes T-V through W-V are based on J3/J4 Compressors.

INTRODUCTION

GENERAL

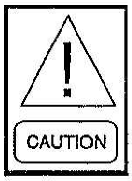
This instruction describes the installation of a MODEL YK Millennium Liquid Chilling Unit. This unit is shipped as a single factory assembled, piped, wired package, requiring a minimum of field labor to make chilled water connections, condenser water connections, refrigerant atmospheric relief connections, and electrical power connections. (Refrigerant and oil charges shipped separately unless optional condensor isolation valves are ordered.)

Chillers can also be shipped dismantled when required by rigging conditions, but generally it is more economical to enlarge access openings to accommodate the factory assembled unit. Chillers shipped dismantled MUST be field assembled under the supervision of a YORK representative, but otherwise installation will be as described in this instruction.

FIELD ASSEMBLED UNITS ONLY

Use Form 160.54-N3 in conjunction with this installation instruction. This instruction will be furnished with all units that are to be field assembled. Extra copies may be ordered from the York Publication Distribution Center.

The services of a YORK representative will be furnished to check the installation, supervise the initial start-up and operation of all chillers installed within Continental United States.



The YORK Warranty may be voided if the following restrictions are not adhered to:

1. *No valves or connections should be opened under any circumstances because such action will result in loss of the factory nitrogen charge.*
2. *Do not dismantle or open the chiller for any reason except under the supervision of a YORK representative.*
3. *When units are shipped dismantled, notify the nearest YORK office in ample time for a YORK representative to supervise rigging the unit to its operating position and the assembly of components.*
4. *Do not make final power supply connections to the compressor motor or control center.*
5. *Do not charge the compressor with oil.*
6. *Do not charge the unit with refrigerant.*
7. *Do not attempt to start the system.*
8. *Do not run hot water (110°F max.) or steam through the cooler or condenser at any time.*

SHIPMENT

The chiller may be ordered and shipped in any of the following forms:

Form 1 – Factory Assembled Unit, complete with motor, refrigerant and oil charges.

1. The motor/compressor assembly mounted, with all necessary interconnecting piping assembled. MicroComputer Control Center is mounted on the unit. Complete unit factory leak tested, evacuated and charged with R-134A.

   An optional Solid State Starter or Variable Speed Drive can be factory mounted and wired.

2. Miscellaneous material – Four (4) vibration isolation pads (or optional spring isolators and brackets).

Form 2 – Factory Assembled Unit, complete with motor (refrigerant and oil charges shipped separately).

1. The motor/compressor assembly mounted, with all necessary interconnecting piping assembled. MicroComputer Control Center is mounted on the unit. Complete unit factory leak tested, evacuated and charged with holding charge of nitrogen.

   An optional Solid State Starter or Variable Speed Drive can be factory mounted and wired.

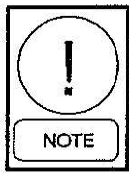
2. Miscellaneous material – Four (4) vibration isolation pads (or optional spring isolators and brackets).

Form 3 – Driveline Separate From Shells – Shipped as three major assemblies. Unit first factory assembled, refrigerant piped, wired and leak tested; then dismantled for shipment. Compressor/motor assembly removed from shells

and skidded. Cooler/condenser is not skidded.

All wiring integral with compressor is left on it, and all conduit is left on shell. All openings on compressor, oil separator, and shell are closed and charged with dry nitrogen (2 to 3 PSIG).

Miscellaneous packaging of control center, tubing, water temperature controls, wiring, oil, isolators, solid state starter (option), etc.; refrigerant charge shipped separately.



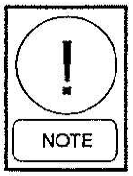
Units shipped dismantled MUST be reassembled by, or under the supervision of, a YORK representative. (See Form 160.54-N3)

Form 7 – Split Shells – Shipped as four major assemblies. Unit first factory assembled, refrigerant piped, wired and leak tested; then dismantled for shipment. Compressor/motor assembly removed from shells and skidded.

Cooler and condenser shells are separated at tube sheets and are not skidded. Refrigerant lines between shells are flanged and capped, requiring no welding.

All wiring integral with compressor is left on it. All wiring harnesses on shells are removed. All openings on compressor and shells are closed and charged with dry nitrogen (2 to 3 PSIG).

Miscellaneous packaging of control center, tubing, water temperature controls, wiring, oil isolators, solid state starter (option), etc.; refrigerant charge shipped separately.



Units shipped dismantled MUST be reassembled by, or under the supervision of, a YORK representative. (See Form 160.54-N3)

When more than one chiller is involved, the major parts of each unit will be marked to prevent mixing of assemblies. (Piping and Wiring Drawings to be furnished by YORK.)

INSPECTION – DAMAGE – SHORTAGE

The unit shipment should be checked on arrival to see that all major pieces, boxes and crates are received. Each unit should be checked on the trailer or rail car when received, before unloading, for any visible signs of damage. Any damage or signs of possible damage must be reported to the transportation company immediately for their inspection.

YORK WILL NOT BE RESPONSIBLE FOR ANY DAMAGE IN SHIPMENT OR AT JOB SITE OR LOSS OF PARTS. (Refer to Shipping Damage Claims, Form 50.15-NM)

When received at the job site all containers should be opened and contents checked against the packing list. Any material shortage should be reported to YORK immediately. (Refer to Shipping Damage Claims, Form 50.15-NM)

CHILLER DATA PLATE

A unit data plate is mounted on the control center assembly of each unit, giving unit model number; design working pressure; water passes; refrigerant charge; serial numbers; and motor power characteristics and connection diagrams.

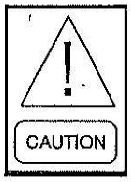
Additional information may be found on the motor data plate. This information should be included when contacting the factory on any problem relating to the motor.

RIGGING (See Fig. 4)

The complete standard chiller is shipped without skids. (When optional skids are used it may be necessary to remove the skids so riggers skates can be used under the unit end sheets to reduce overall height.)

Each unit has four (4) lifting holes (two in each end) in the end sheets which should be used to lift the unit.

Care should be taken at all times during rigging and handling of the chiller to avoid damage to the unit and its external connections. Lift only using holes shown in Fig. 4.



Do not lift the unit with slings around motor/compressor assembly or by means of eyebolts in the tapped holes of the compressor motor assembly. Do not turn a unit on its side for rigging. Do not rig vertically.

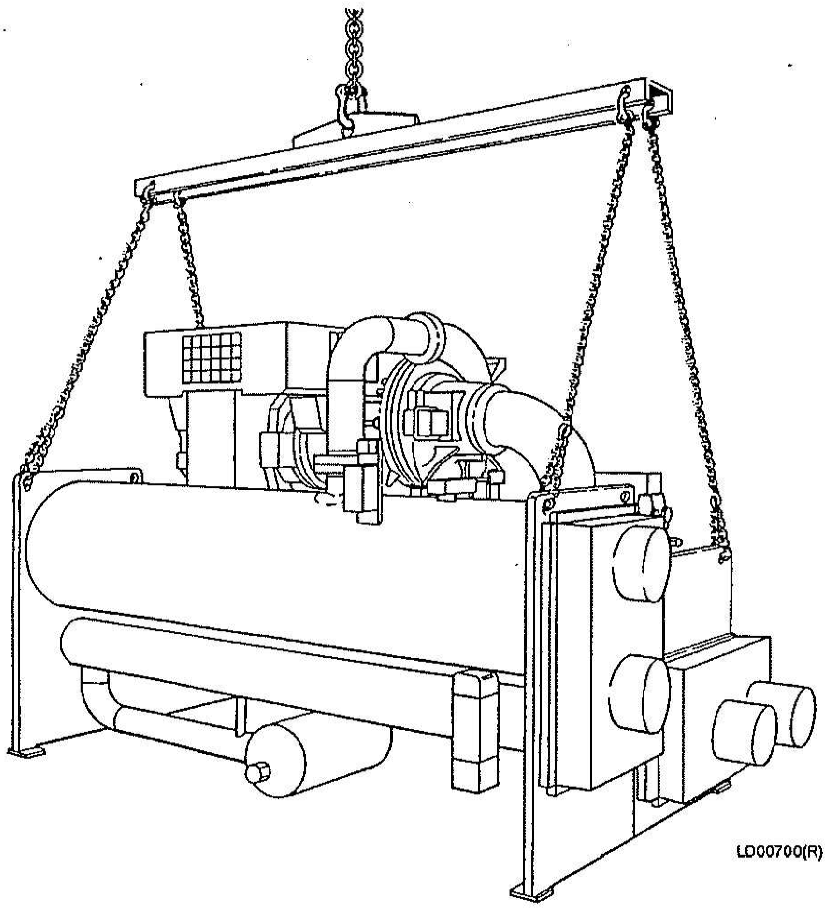


FIG. 9 – RIGGING

The rigging and operating weights and overall dimensions are given on pages 6 thru 13 as a guide in determining the clearances required for rigging. (Add 6" to overall height for optional skidded unit.)

LOCATION

YORK Millennium Chillers are furnished with vibration isolator mounts for basement or ground level installations. Units may be located on upper floor levels providing the floor is capable of supporting the total unit operating weight and optional spring isolators are used.

CAUTION

Sufficient clearance to facilitate normal service and maintenance work must be provided all around and above the unit and particularly space provided at either end to permit cleaning or replacement of cooler and condenser tubes – see CLEARANCE.

A doorway or other sufficiently large opening properly located may be used. The chiller should be located in an indoor location where temperatures range from 40°F to 110°F (4.4°C to 43.3°C).

MOTORS

The YK open motor is air cooled. Check state, local and other codes for ventilation requirements.

FOUNDATION

A level floor, mounting pad or foundation must be provided by others, capable of supporting the operating weight of the unit.

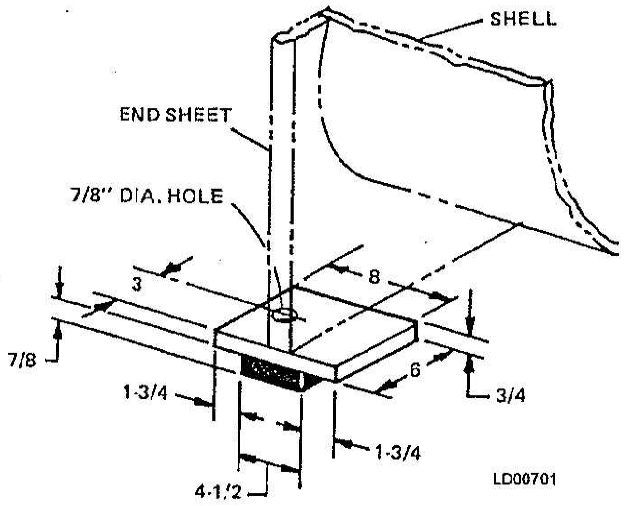
CLEARANCE

Clearances should be adhered to as follows:

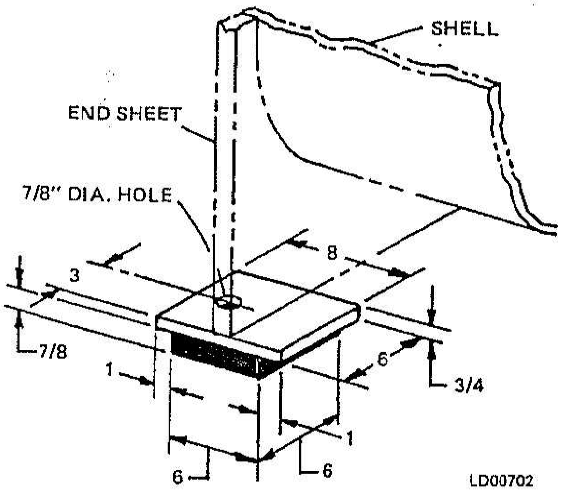
Rear and above unit – 2 ft.
Front of unit – 3 ft.
Tube Removal – 14 ft.* (either end)

* 16 ft. on shell codes T-T, T-V, V-T, V-V & W-V.

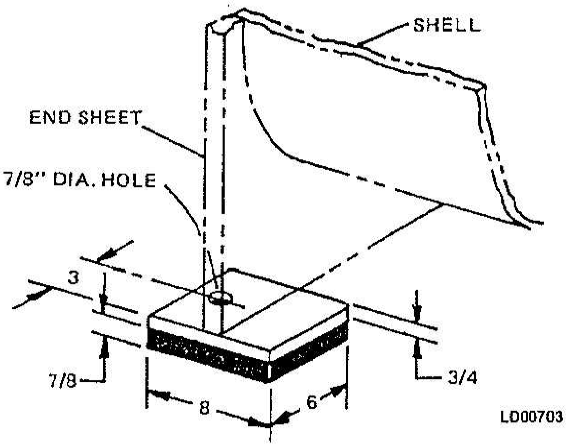
ALL DIMENSIONS ARE IN INCHES



UNIT WEIGHT UP TO 28,835 LBS.



UNIT WEIGHT 28,836 TO 53,530 LBS.



UNIT WEIGHT 53,531 TO 100,464 LBS.

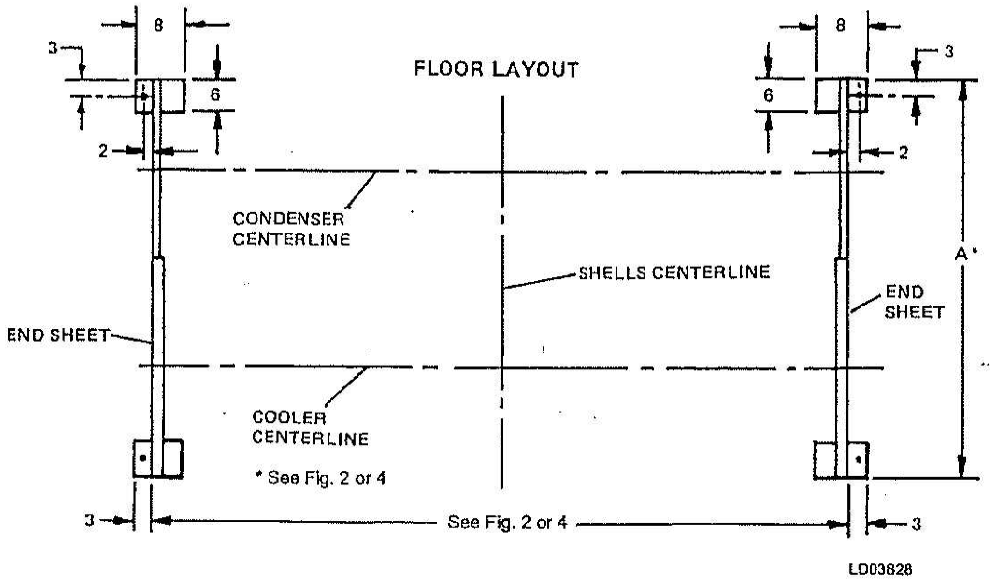
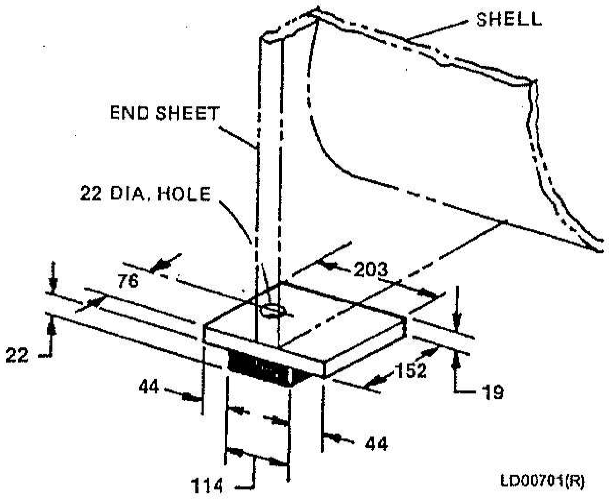
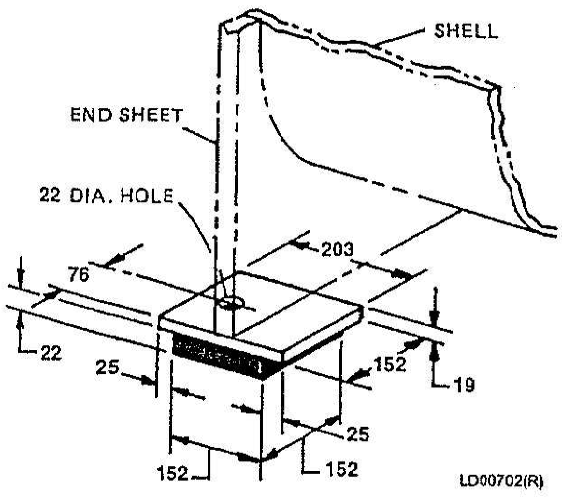


FIG. 10 – NEOPRENE ISOLATORS (STANDARD DIMENSIONS)

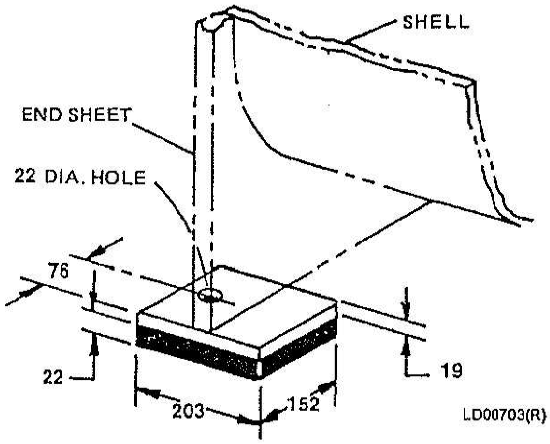
ALL DIMENSIONS ARE IN MILLIMETERS



UNIT WEIGHT UP TO 13,080 Kgs.



UNIT WEIGHT 13,081 TO 24,281 Kgs.



UNIT WEIGHT 24,282 TO 45,570 Kgs.

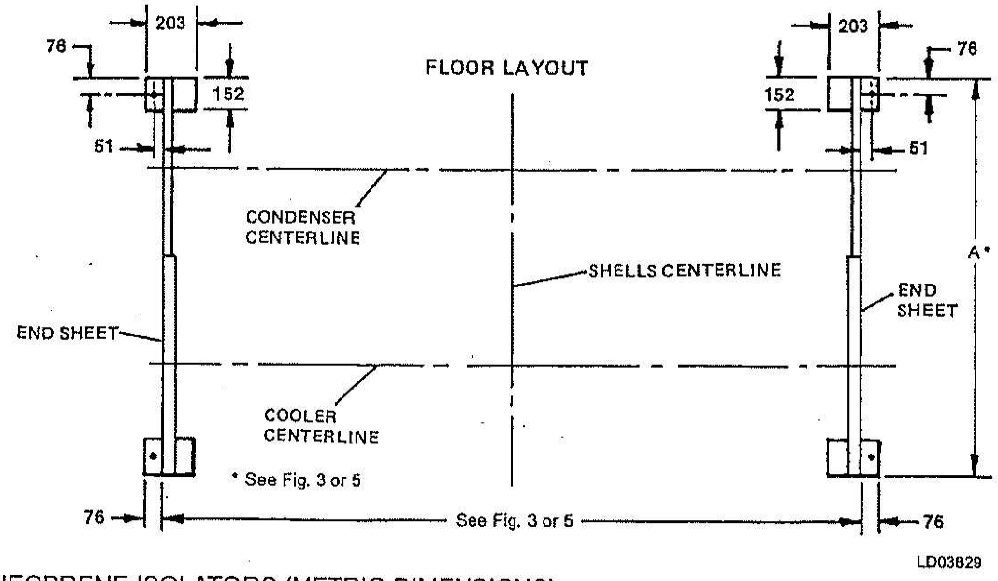
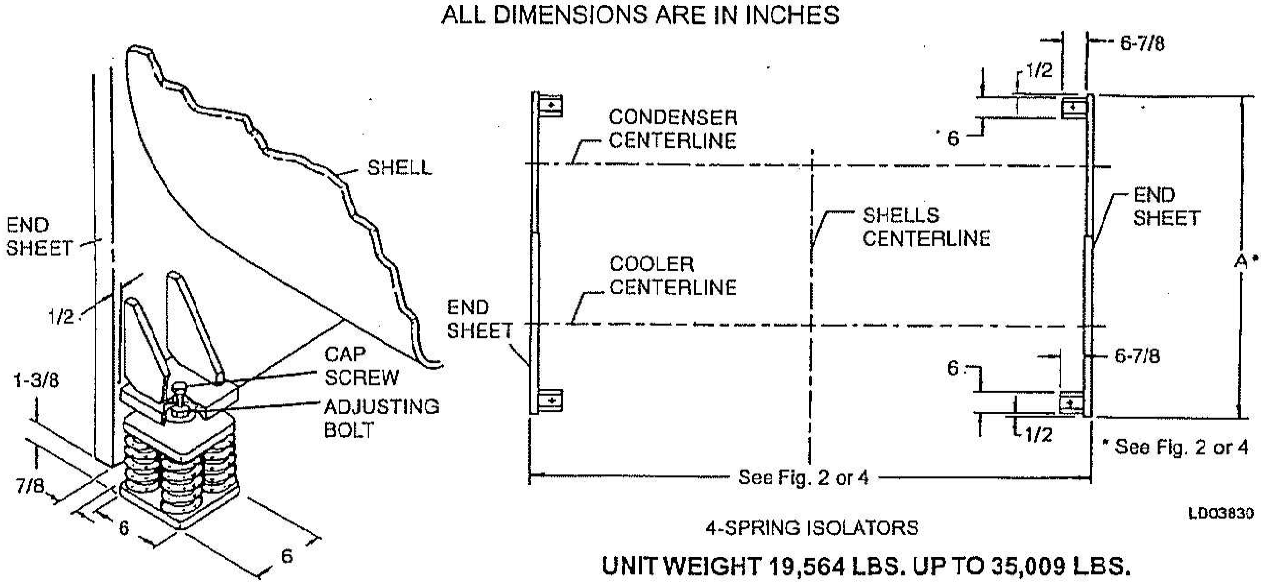


FIG. 11 – NEOPRENE ISOLATORS (METRIC DIMENSIONS)

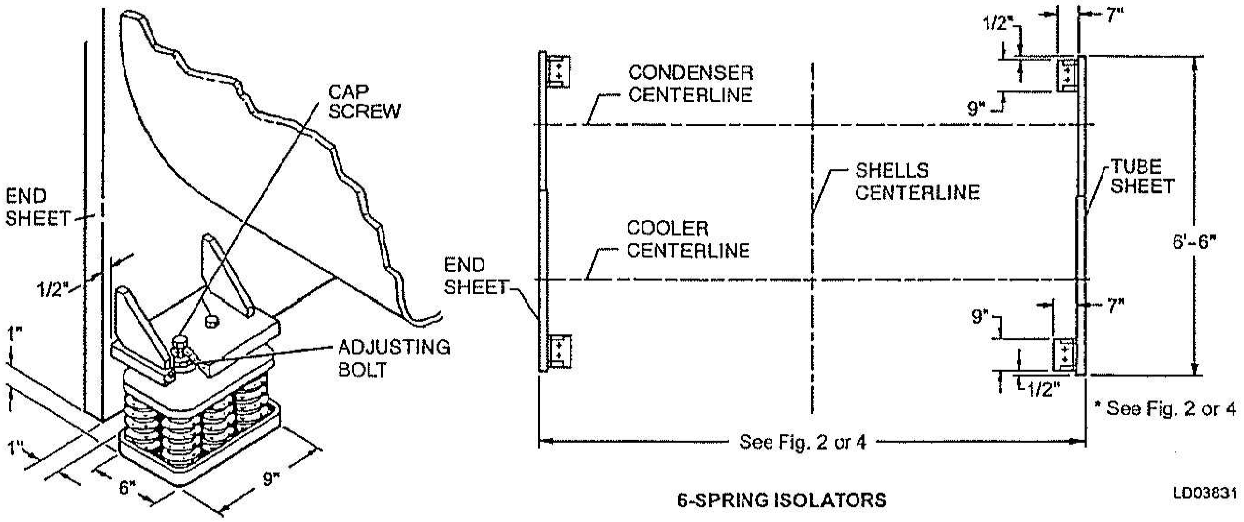
ALL DIMENSIONS ARE IN INCHES



4-SPRING ISOLATORS

LD03830

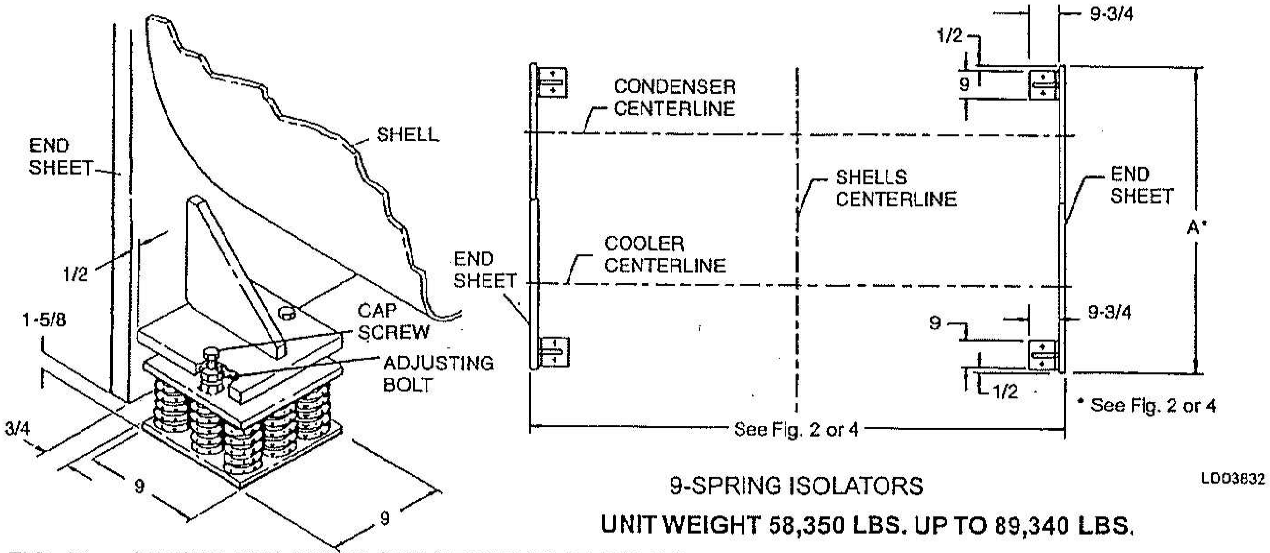
UNIT WEIGHT 19,564 LBS. UP TO 35,009 LBS.



6-SPRING ISOLATORS

LD03831

UNIT WEIGHT 35,010 LBS. UP TO 58,349 LBS.



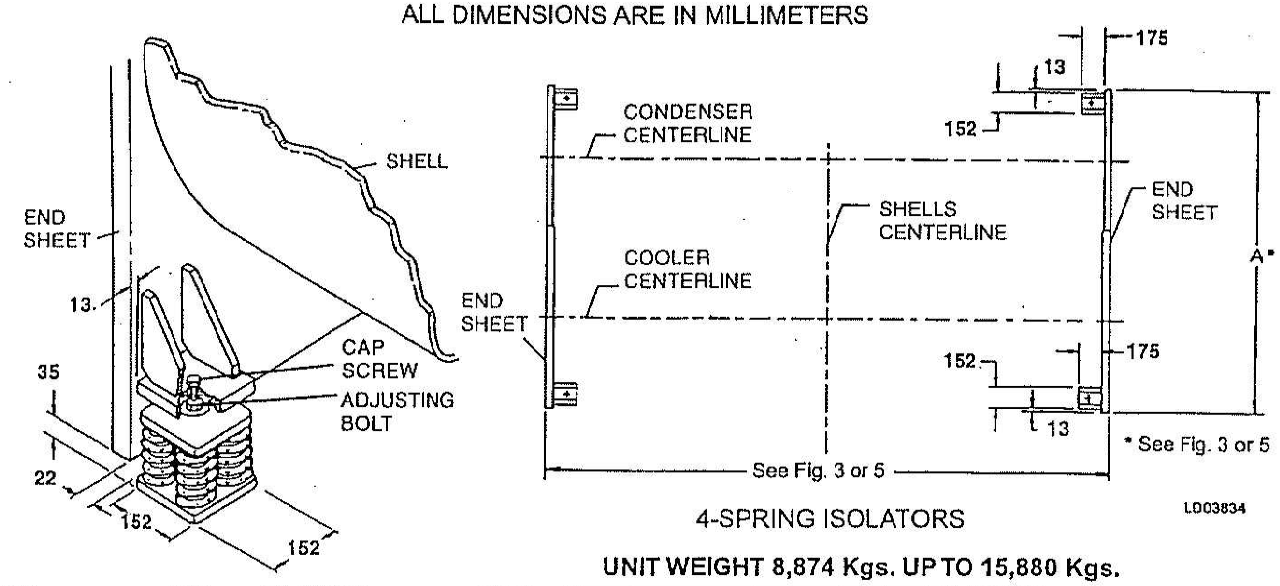
9-SPRING ISOLATORS

LD03832

UNIT WEIGHT 58,350 LBS. UP TO 89,340 LBS.

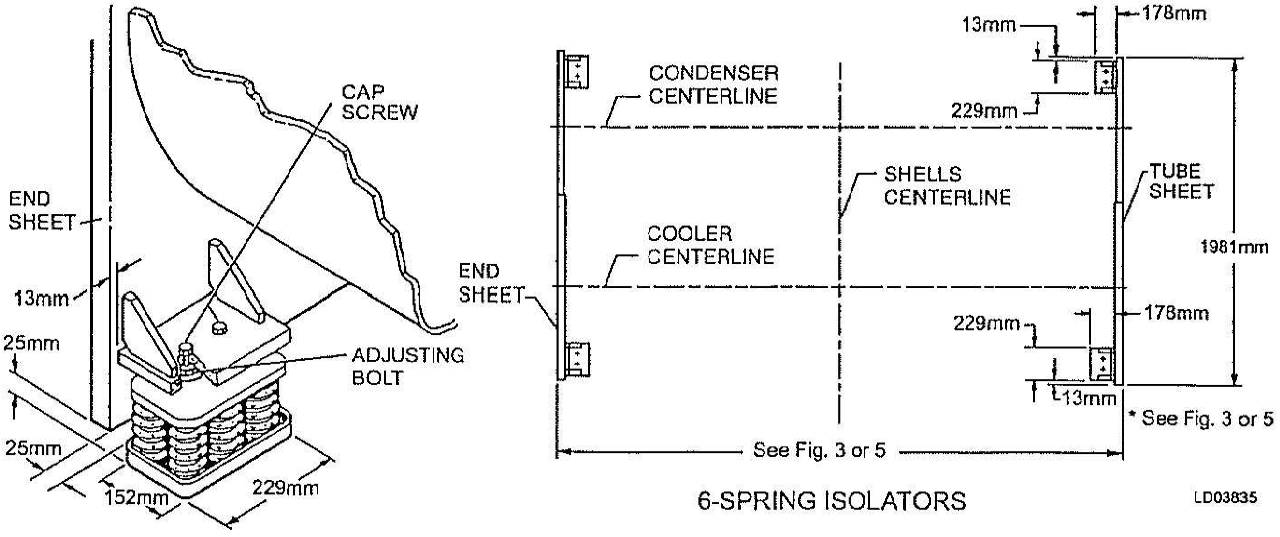
FIG. 12 – SPRING ISOLATORS (STANDARD DIMENSIONS)

ALL DIMENSIONS ARE IN MILLIMETERS



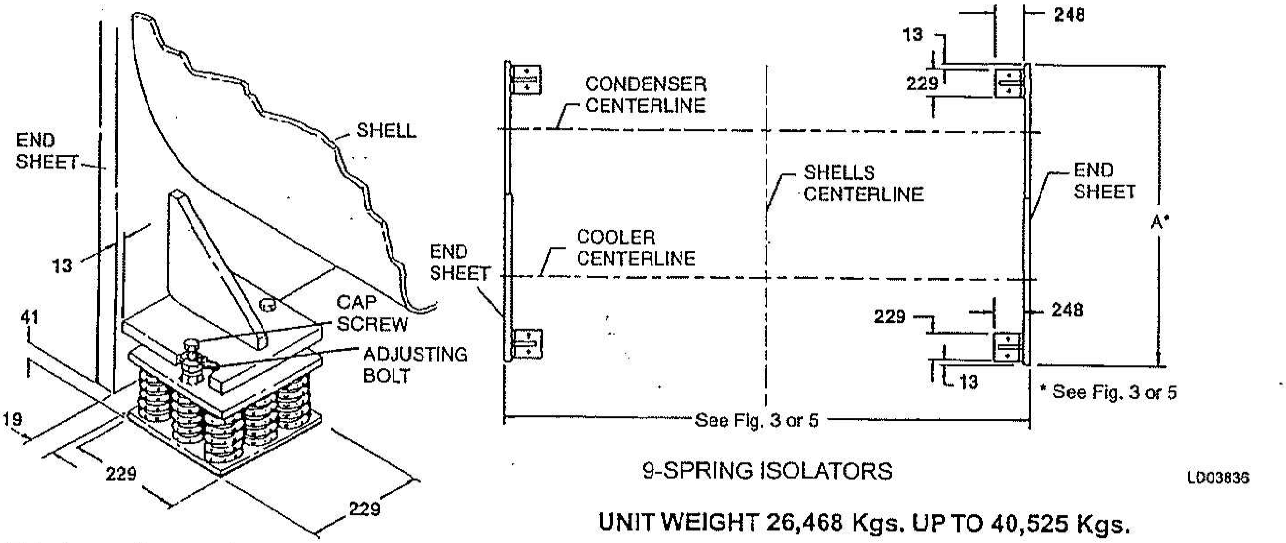
4-SPRING ISOLATORS

UNIT WEIGHT 8,874 Kgs. UP TO 15,880 Kgs.



6-SPRING ISOLATORS

UNIT WEIGHT 15,881 Kgs. UP TO 26,467 Kgs.



9-SPRING ISOLATORS

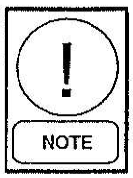
UNIT WEIGHT 26,468 Kgs. UP TO 40,525 Kgs.

FIG. 13 – SPRING ISOLATORS (METRIC DIMENSIONS)

INSTALLATION

RIGGING UNIT TO FINAL LOCATION

Rig the unit to its final location on the floor or mounting pad, lift the unit (or shell assembly) by means of an overhead lift and lower the unit to its mounting position. (If optional shipping skids are used, remove them before lowering the chiller to its mounting position.)



At this point units shipped dismantled should be assembled under the supervision of a YORK representative.

If cooler is to be field insulated, the insulation should be applied to the cooler before the unit is placed in position while the unit is in the lift position. Be sure unit is properly supported. (See INSULATION, page 27.)

LOCATING AND INSTALLING ISOLATOR PADS (REFER TO FIG. 10 OR 11)

The isolator pad mounts are to be located as shown in Fig 10.

After the isolator pads have been placed into position on the floor, lower the chiller onto the pads. When the unit is in place, remove the rigging equipment and check that the unit is level both longitudinally and transversely. The unit should be level within 1/4" from one end to the other end and from front to the rear. If the chiller is not level within the amount specified, lift it and place shims between the isolation pad and the chiller tube sheets. (Shims furnished by the installer.) Lower unit again and recheck to see that it is level.

CHECKING THE ISOLATION PAD DEFLECTION

All isolation pads should be checked for the proper deflection while checking to see if the unit is level. Each pad should be deflected approximately 0.15 inch. If an isolation pad is under-deflected, shims should be placed between the unit tube sheet and the top of the pad to equally deflect all pads.

LEVELING THE UNIT

The longitudinal alignment of the unit should be checked by placing a level on the top center of the cooler shell under the compressor/motor assembly. Transverse alignment should be checked by placing a level on top of the shell end sheets at each end of the chiller.

INSTALLING OPTIONAL SPRING ISOLATORS (REFER TO FIG. 12 OR 13)

When ordered, 4 spring type isolator assemblies will be furnished with the unit. The 4 assemblies are identical and can be placed at any of the 4 corners of the unit.

While the unit is still suspended by the rigging, the isolators should be bolted to the unit by inserting the cap screw(s) through the hole(s) in the mounting bracket into the tapped hole in the top of the isolator leveling bolt(s). Then the unit can be lowered onto the floor.

The leveling bolts should now be rotated one (1) turn at a time, in sequence, until the unit end sheets are clear of the floor by the dimension shown in Fig. 12 or 13 and the unit is level. Check that the unit is level, both longitudinally and transversely (see Leveling the Unit). If the leveling bolts are not long enough to level unit due to an uneven or sloping floor or foundation, steel shims (grouted, if necessary) must be added beneath the isolator assemblies as necessary.

After the unit is leveled, wedge and shim under each corner to solidly support the unit in this position while piping connections are being made, pipe hangers adjusted and connections checked for alignment. Then the unit is filled with water and checked for leaks. The leveling bolts should now be finally adjusted until the wedges and shims can be removed. The unit should now be in correct level position, clear of the floor or foundation and without any effect from the weight of the piping.

PIPING CONNECTIONS

After the unit is leveled (and wedged in place for optional spring isolators) the piping connections may be made; chilled water, condenser water and refrigerant relief. The piping should be arranged with offsets for flexibility, and adequately supported and braced independently of the unit to avoid strain on the unit and vibration transmission. Hangers must allow for alignment of pipe. Isolators (by others) in the piping and hangers are highly desirable, and may be required by specifications, in order to effectively utilize the vibration isolation characteristics of the vibration isolation mounts of the unit.

Check for piping alignment – Upon completion of piping, a connection in each line as close to the unit as possible should be opened, by removing the flange bolts or coupling and checked for piping alignment. If any of the bolts are bound in their holes, or if the connection springs are out of alignment, the misalignment must be

corrected by properly supporting the piping or by applying heat to anneal the pipe.

NOTE

If the piping is annealed to relieve stress, the inside of the pipe must be cleaned of scale before it is finally bolted in place.

COOLER AND CONDENSER WATER PIPING

The cooler and condenser liquid heads of chiller have nozzles which are grooved, suitable for welding 150 PSIG DWP flanges or the use of Victaulic couplings. Factory mounted flanges are optional.

The nozzles and water pass arrangements are furnished in accordance with the job requirements (see Product Drawings) furnished with the job. Standard units are designed for 150 PSIG DWP on the water side. If job requirements are for greater than 150 PSIG DWP, check the unit data plate before applying pressure to cooler or condenser to determine if the chiller has provisions for the required DWP.

Inlet and outlet connections are identified by labels placed adjacent to each nozzle.

Chilled Water

Foreign objects which could lodge in, or block flow through, the cooler and condenser tubes must be kept out of the water circuit. All water piping must be cleaned or flushed before being connected to the chiller pumps, or other equipment.

Permanent strainers (supplied by others) are required in both the cooler and condenser water circuits to protect the chiller as well as the pumps, tower spray nozzles, chilled water coils and controls, etc. The strainer should be installed in the entering chilled water line, directly upstream of the chiller.

Water piping circuits should be arranged so that the pumps discharge through the chiller, and should be controlled as necessary to maintain essentially constant chilled and condenser water flows through the unit at all load conditions.

If pumps discharge through the chiller, the strainer may be located upstream from pumps to protect both pump and chiller. (Piping between strainer, pump and chiller must be very carefully cleaned before start-up.) If pumps are remotely installed from chiller, strainers should be located directly upstream of the chiller.

Condenser Water Circuit

For proper operation of the unit, condenser refrigerant pressure must be maintained above cooler pressure. If operating conditions will fulfill this requirement, no attempt should be made to control condenser water temperature by means of automatic valves, cycling of the cooling tower fan or other means, since chillers are designed to function satisfactorily and efficiently when condenser water is allowed to seek its own temperature level at reduced loads and off-peak seasons of the year. However, if entering condenser water temperature can go below the required minimum, (refer to 160.54-O1) condenser water temperature must be maintained equal to or slightly higher than the required minimum. Refer to Fig. 14 for typical water piping schematic.

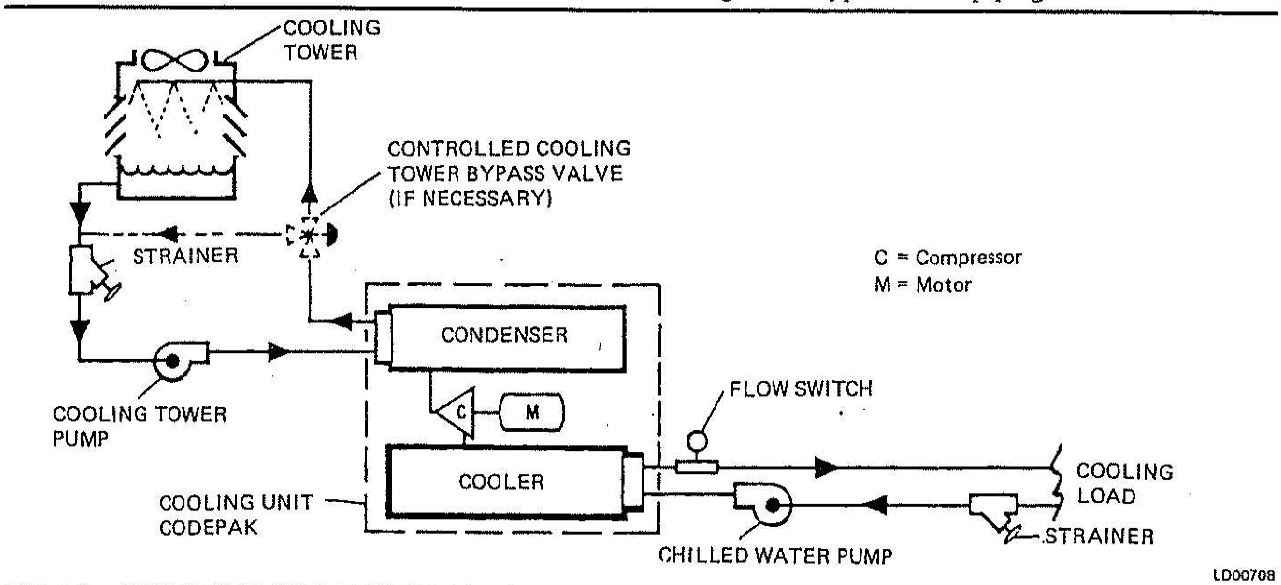


FIG. 14 – SCHEMATIC OF A TYPICAL PIPING ARRANGEMENT

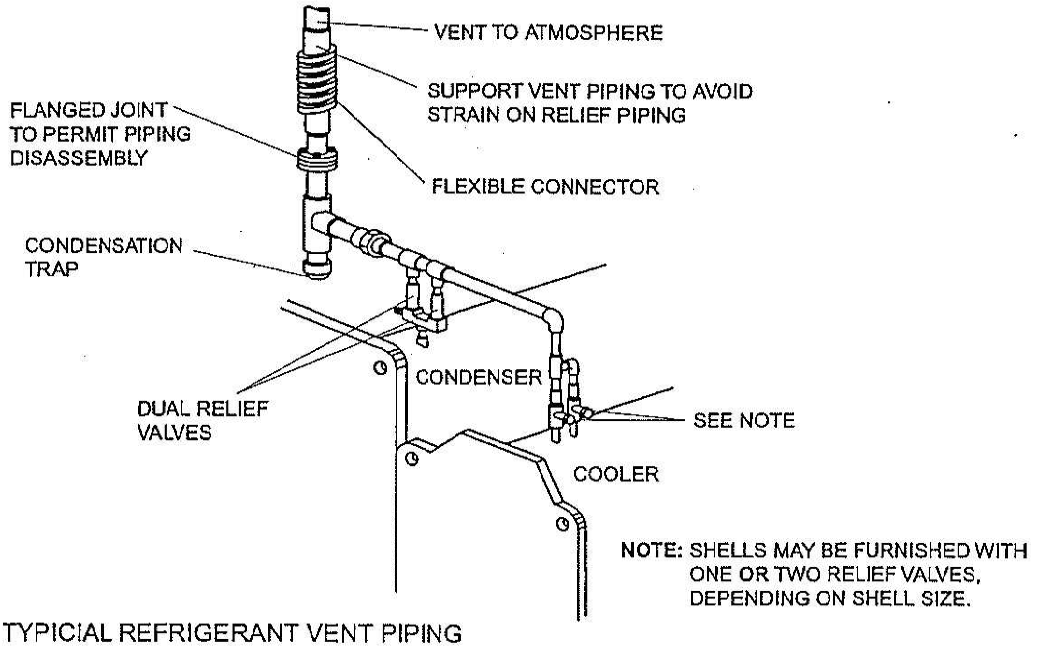


FIG. 15 – TYPICIAL REFRIGERANT VENT PIPING

Stop Valves

Stop valves may be provided (by others) in the cooler and condenser water piping adjacent to the unit to facilitate maintenance. Thermometer wells and pressure taps should be provided (by others) in the piping as close to the unit as possible to facilitate operating check.

Flow Switches (Field Installed)

A flow switch or pressure differential control in the chilled water line(s) adjacent to the unit is an accessory furnished for connection to the control center. If a flow switch is used, it must be directly in series with the chiller and sensing only water flow through the chiller. The differential switch must sense pressure drop across the unit.

Drain and Vent Valves

Drain and vent valves (by others) should be installed in the connections provided in the cooler and condenser liquid heads. These connections may be piped to drain if desired.

Checking Piping Circuits and Venting Air

After the water piping is completed, but before any water box insulation is applied. Tighten and torque (to maintain between 30 and 60 ft. lbs.) the nuts on the liquid head flanges. Gasket shrinkage and handling during transit cause nuts to loosen. If water pressure is applied before tightening is done, the gaskets may be damaged and have to be replaced. Fill the chilled and condenser water circuits, operate the pumps manually and carefully check the cooler and condenser water heads and piping for leaks. Repair leaks as necessary.

Before initial operation of the unit both water circuits should be thoroughly vented of all air at the high points.

REFRIGERANT RELIEF PIPING

Each unit is equipped with pressure relief valves located on the condenser and on the evaporator for the purpose of quickly relieving excess pressure of the refrigerant charge to the atmosphere as a safety precaution in case of an emergency, such as fire.

Refrigerant relief vent piping (by others), from the relief valves to the outside of the building, is required by code in most areas and should be installed on all chillers. The vent line should be sized in accordance with the ANSI/ASHRAE-15, or local code. The vent line must include a dirt trap in the vertical leg to intercept and permit clean out and to trap any vent stack condensation. The piping MUST be arranged to avoid strain on the relief valves, using a flexible connection, if necessary.

UNIT PIPING

Compressor lubricant piping and system external piping are factory installed on all units shipped assembled. On units shipped dismantled, the following piping should be completed under the supervision of the YORK representative: (1) the lubricant piping to oil sump and oil cooler and system oil return connections using material furnished. See Form 160.54-N3.

CONTROL PANEL POSITIONING (See Fig. 16)

On units with cooler codes G thru W, the Graphic Control Center is placed in a position above the cooler for shipping. To move the control center into position for operation, proceed as follows:

1. While supporting the control center, remove the hardware between the support arms and the cooler.
2. Swing the control center into a vertical position.
3. Slide the control center down the guide rails to the proper position. Tighten securely.
4. Discard unused hardware.

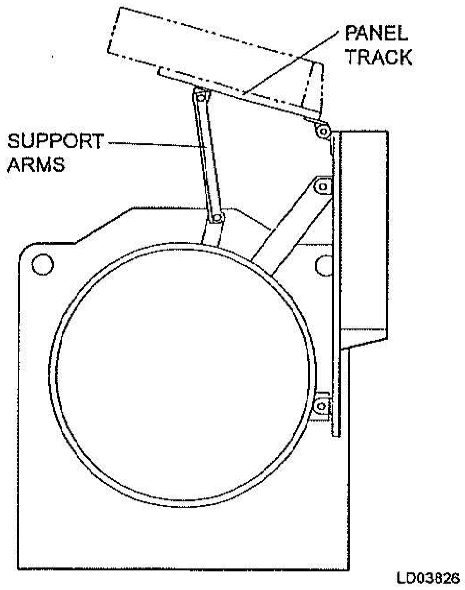


FIG. 16 – CONTROL PANEL POSITIONING

CONTROL WIRING

On units shipped disassembled, after installation of the control center, control wiring must be completed between unit components and control center, solid state starter, or variable speed drive, when used, using wiring harness furnished. Refer to Form 160.54-N3.

Field wiring connections for commonly encountered control modifications (by others) if required, are shown on Form 160.54-PW7.

NOTE

No deviations in unit wiring from that shown on drawings furnished shall be made without prior approval of the YORK representative.

POWER WIRING

Chiller with Electro-Mechanical Starter

A 115 volt – single phase – 60 or 50 Hertz power supply of 15 amperes must be furnished to the control center, from the control transformer (2 KVA required) included with the compressor motor starter. DO NOT make final power connections to control center until approved by YORK representative.

OIL PUMP – 3 PHASE STARTER

Separate wiring or a fused disconnect switch should be supplied by the installer.

NOTE

Remote Electro-Mechanical starters for the chiller must be furnished in accordance with YORK Standard R-1051 (Product Drawing Form 160.45-PA5.1) to provide the features necessary for the starter to function properly with the YORK control system.

Each chiller unit is furnished for a specific electrical power supply as stamped on the Unit Data Plate, which also details the motor connection diagrams.

NOTE

To insure proper motor rotation the starter power input and starter to motor connections must be checked with a phase sequence indicator in the presence of the YORK representative.

CAUTION

DO NOT cut wires to final length or make final connections to motor terminals or starter power input terminals until approved by the YORK representative.

YK Motors (Electro-Mechanical Starter)

Fig. 17 shows the power wiring hook-up for Motor Connections. (Refer to Wiring Labels in Motor Terminal Box for hook-up to suit motor voltage and amperage.)

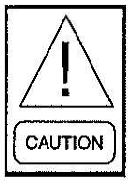
Motor leads are furnished with a crimp type connection

having a clearance hole for a 3/8" bolt, motor terminal lugs are not furnished.

Chiller with Solid State Starter or Variable Speed Drive

A chiller equipped with a Solid State Starter or Variable Speed Drive does not require wiring to the compressor motor. The motor power wiring is factory connected to the Solid State Starter or Variable Speed Drive (or an optional factory installed disconnect switch). See Field Wiring Diagram. All wiring to the control panel and the oil pump starter is completed by the factory. A control transformer is furnished with the Solid State Starter or Variable Speed Drive.

INSULATION (SEE PRODUCT DRAWINGS FORM 160.52-PA1)



DO NOT field insulate until the unit has been leak tested under the supervision of the YORK representative.

Insulation of the type specified for the job, or minimum thickness to prevent sweating of 30°F surfaces should be furnished (by others) and applied to the cooler shell, end sheets, liquid feed line to flow chamber, compressor suction connection, and cooler liquid heads and connections. The liquid head flange insulation must be removable, to allow head removal for the tube maintenance. Details of areas to be insulated are given on the Product Drawing.

Units are furnished factory anti-sweat insulated on order at additional cost. This includes all low temperature surfaces except the two (2) cooler liquid heads.

INSTALLATION CHECK – REQUEST FOR START-UP SERVICE

The services of a YORK representative will be furnished to check the installation and supervise the initial start-up and operation on all chillers installed within the Continental United States.

After the unit is installed, piped and wired as described in this Instruction, but before any attempt is made to start the unit, the YORK District Office should be advised so that the start-up service, included in the contract price, can be scheduled. Notification to the YORK office should be by means of Installation Check List and Request, Form 160.49-CL1, in triplicate.

3 PHASE MOTOR VOLTAGE	MOTOR RATED LOAD AMPS CT RATIO			
50 / 60 Hz	200:1	350:1	700:1	1400:1
200-600	65-111[A]	112-224[A]	225-829[A]	830-1790[A]
2300-4160	11-18[C] 19-37[B] 38-123[A]	124-264[A]	265-518[A]	

NOTES:

A. Requires passing motor lead thru current transformer (CT) once before connecting to power supply.
B. Requires passing motor lead thru CT twice before connecting to power supply.
C. Requires passing motor lead thru CT three times before connecting to power supply.

COMPRESSOR MOTOR FIELD CONNECTION DIAGRAM

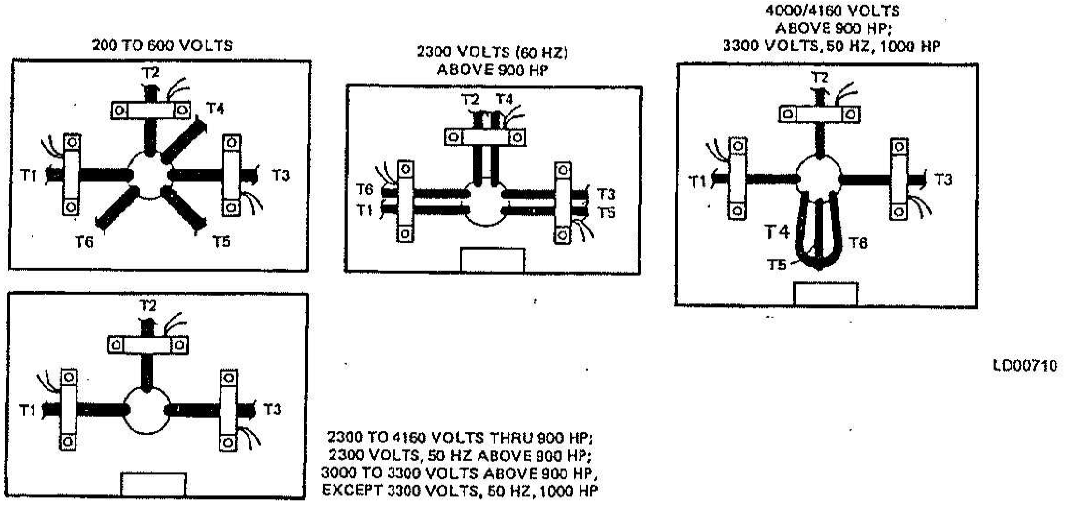


FIG. 17 – MOTOR CONNECTIONS (ELECTRO MECHANICAL STARTER APPLICATION)

YORK INTERNATIONAL CORPORATION

Philadelphia Applied Systems
75 Great Valley Parkway
Malvern, PA 19355
800-528-YORK

SECTION 1

Form 7 Reassemble

DEL CASTLE CHILLER

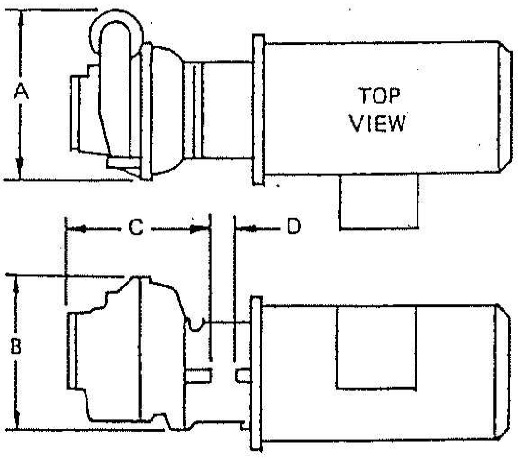


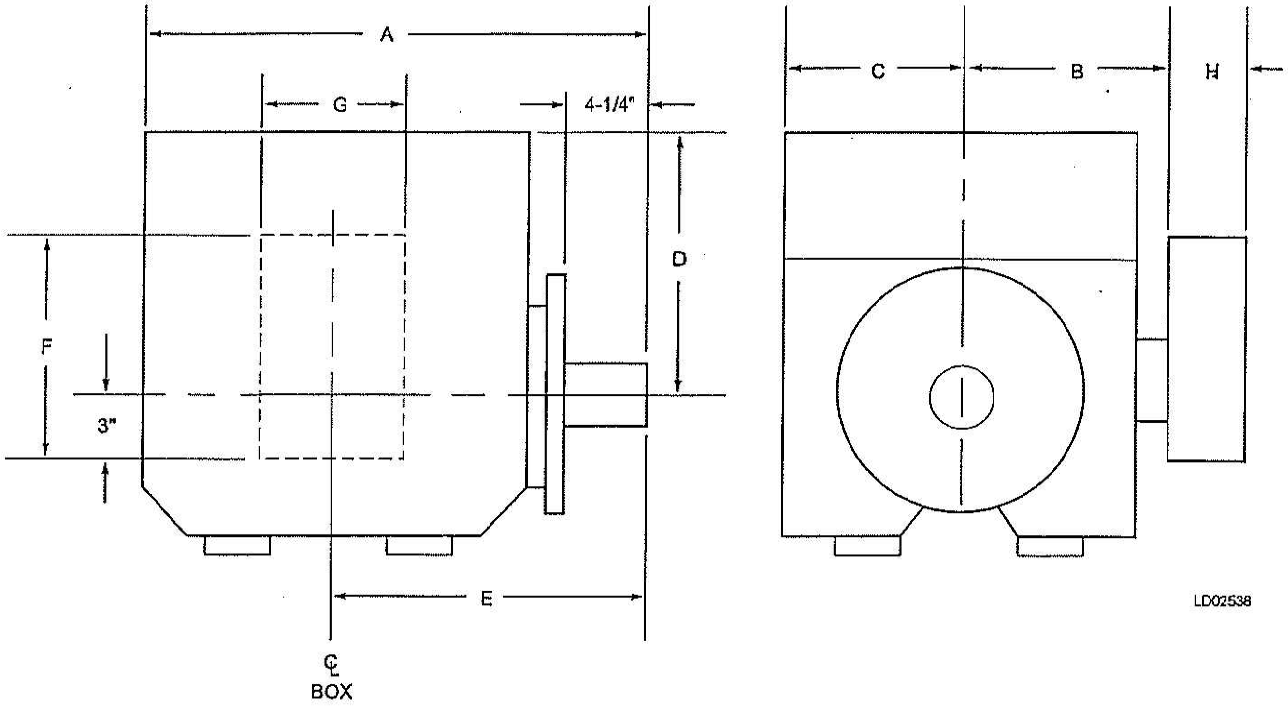
FIG. 7 – MOTOR COMPRESSOR DIMENSIONS

COMPRESSOR WEIGHTS (Lbs. and Kg.)

COMPRESSOR CODE	WEIGHT	
	LBS.	KG
G4, H0/H4, H1/H5, H2/H6/H7 & H3/H8	3,500	1,588
J1 & J2	4,000	1,814
J3 & J4	5,000	2,268

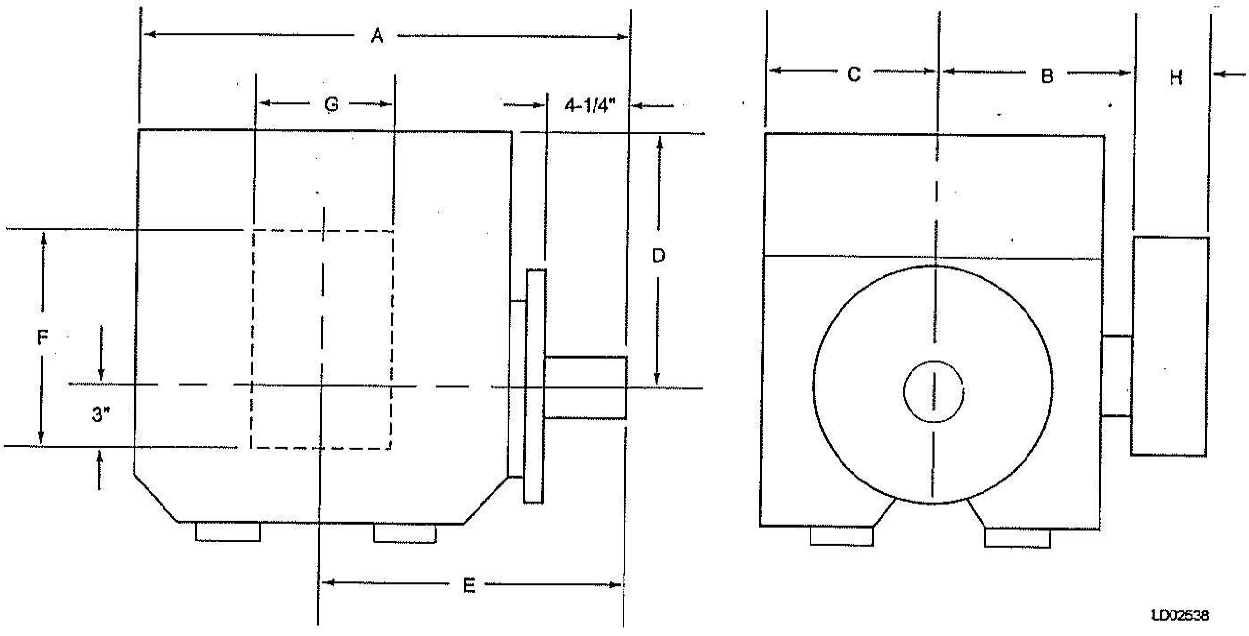
COMPR./ MOTOR	A	B	C	D
G4	3'–4-3/8"	3'–1-3/8"	2'–9-5/8"	6-3/4"
H0/H4	3'–4-3/8"	3'–1-3/8"	2'–9-5/8"	6-3/4"
H1/H5	3'–4-3/8"	3'–1-3/8"	2'–9-5/8"	6-3/4"
H2/H6	3'–6"	3'–1-3/8"	2'–9-5/8"	6-3/4"
H3/H8	3'–6"	3'–1-3/8"	2'–9-5/8"	6-3/4"
J1/J2	3'–11-7/8"	3'–8-1/8"	3'–0-3/4"	7"
J3/J4	4'–7-3/4"	3'–11-1/2"	3'–4-3/4"	7"

COMPR./ MOTOR	A (mm)	B (mm)	C (mm)	D (mm)
G4	1,026	949	854	171
H0/H4	1,026	949	854	171
H1/H5	1,026	949	854	171
H2/H6	1,067	949	854	171
H3/H8	1,067	949	854	171
J1/J2	1,216	1,121	933	178
J3/J4	1,416	1,207	1,035	178



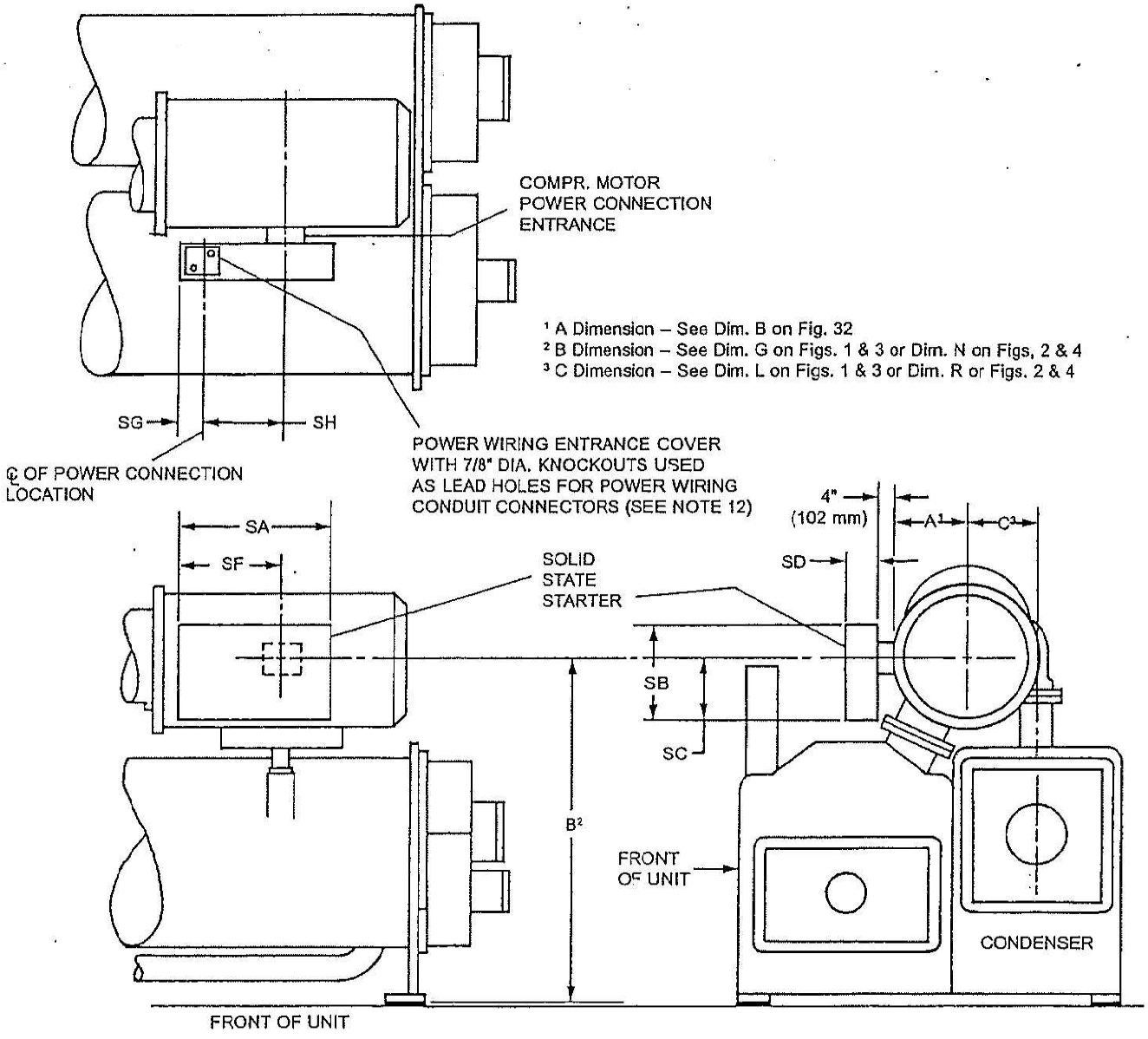
MOTOR CODE		A	B	C	D	E	F	G	H	WEIGHT (LBS.)	WEIGHT (KGS.)
60 HZ	50 HZ										
CH	–	31-1/4"	10-7/8"	10-7/8"	10-1/4"	17-3/4"	20"	20"	8"	940	427
CJ	5CE	31-1/4"	10-7/8"	10-7/8"	10-1/4"	17-3/4"	20"	20"	8"	940	427
CK	5CF	36"	11"	11"	8-1/4"	20"	20"	20"	8"	1,440	653
CL	5CG	36"	11"	11"	8-1/4"	20"	20"	20"	8"	1,440	653
CM	5CH	39-5/8"	11"	11"	8-1/4"	21-3/4"	20"	20"	8"	1,700	771
CN	5C1	39-5/8"	11"	11"	8-1/4"	21-3/4"	20"	20"	8"	1,700	771
CP	5CJ	39-5/8"	11"	11"	8-1/4"	21-3/4"	20"	20"	8"	1,700	771
CR	5CK	39-5/8"	11"	11"	8-1/4"	21-3/4"	20"	20"	8"	1,700	771
CS	5CL	40"	16-1/4"	10-3/4"	11-1/2"	24-1/4"	20"	20"	8"	2,635	1,195
CT	5CM	40"	16-1/4"	10-3/4"	11-1/2"	24-1/4"	20"	20"	8"	2,635	1,195
CU	5CN	40"	16-1/4"	10-3/4"	11-1/2"	24-1/4"	20"	20"	8"	2,635	1,195
CV	5CO	40"	16-1/4"	10-3/4"	11-1/2"	24-1/4"	20"	20"	8"	2,635	1,195
CW	5CP	46-1/8"	19-1/2"	12-1/2"	14-3/4"	24-3/4"	20"	24"	16"	2,930	1,329
CX	5CQ	46-1/8"	19-1/2"	12-1/2"	14-3/4"	24-3/4"	20"	24"	16"	2,930	1,329
CY	5CR	52-1/8"	19-1/2"	12-1/2"	14-3/4"	27-3/4"	20"	24"	16"	2,930	1,329
CZ	5CS	52-1/8"	19-1/2"	12-1/2"	14-3/4"	27-3/4"	20"	24"	16"	2,930	1,329
CA	5CT	57-1/4"	22-1/4"	20"	40-1/4"	32"	20"	24"	17"	5,750	2,608
CB	5CU	57-1/4"	22-1/4"	20"	40-1/4"	32"	20"	24"	17"	5,750	2,608
–	5CV	57-1/4"	22-1/4"	20"	40-1/4"	32"	20"	24"	17"	5,750	2,608
DA	5CW	65-1/4"	22-1/4"	20"	40-1/4"	36"	20"	24"	17"	6,800	3,084
DB	5CX	65-1/4"	22-1/4"	20"	40-1/4"	36"	20"	24"	17"	6,800	3,084
DC	5DA	65-1/4"	22-1/4"	20"	40-1/4"	36"	20"	24"	17"	7,300	3,311
–	5DB	65-1/2"	22-1/4"	20"	40-1/4"	36-1/4"	20"	24"	17"	7,300	3,311

FIG. 32 – TYPICAL DIMENSIONS AND WEIGHTS - STANDARD MOTORS (LOW VOLTAGE)



MOTOR CODE		A	B	C	D	E	F	G	H	WEIGHT (LBS.)	WEIGHT (KGS.)
60 HZ	50 HZ										
CH	–	41-1/2"	20-7/8"	20-7/8"	30-3/8"	22-3/4"	20"	20"	8"	2,670	1,211
CJ	5CE	41-1/2"	20-7/8"	20-7/8"	30-3/8"	22-3/4"	20"	20"	8"	2,670	1,211
CK	5CF	46"	20-7/8"	20-7/8"	30-3/8"	24-3/4"	20"	20"	8"	3,100	1,406
CL	5CG	46"	20-7/8"	20-7/8"	30-3/8"	24-3/4"	20"	20"	8"	3,100	1,406
CM	5CH	46"	20-7/8"	20-7/8"	30-3/8"	24-3/4"	20"	20"	8"	3,100	1,406
CN	5C1	46"	20-7/8"	20-7/8"	30-3/8"	24-3/4"	20"	20"	8"	3,100	1,406
CP	5CJ	51-7/8"	20-7/8"	20-7/8"	30-3/8"	27-3/4"	20"	20"	8"	3,700	1,678
CR	5CK	51-7/8"	20-7/8"	20-7/8"	30-3/8"	27-3/4"	20"	20"	8"	3,700	1,678
CS	5CL	51-7/8"	20-7/8"	20-7/8"	30-3/8"	27-3/4"	20"	20"	8"	3,700	1,678
CT	5CM	51-7/8"	20-7/8"	20-7/8"	30-3/8"	27-3/4"	20"	20"	8"	3,700	1,678
CU	5CN	51-7/8"	20-7/8"	20-7/8"	30-3/8"	27-3/4"	20"	20"	8"	3,700	1,678
CV	5CO	57"	19"	14"	35-5/8"	32-1/4"	20"	20"	8"	4,500	2,041
CW	5CP	57"	19"	14"	35-5/8"	32-1/4"	20"	20"	8"	4,500	2,041
CX	5CQ	57"	19"	14"	35-5/8"	32-1/4"	20"	20"	8"	4,500	2,041
CY	5CR	57"	19"	14"	35-5/8"	32-1/4"	20"	24"	8"	4,500	2,041
CZ	5CS	57"	19"	14"	35-5/8"	32-1/4"	20"	24"	8"	4,500	2,041
CA	5CT	57-1/4"	22-1/4"	20"	40-1/4"	32"	20"	24"	17"	5,800	2,630
CB	5CU	57-1/4"	22-1/4"	20"	40-1/4"	32"	20"	24"	17"	5,800	2,630
–	5CV	57-1/4"	22-1/4"	20"	40-1/4"	32"	20"	24"	17"	5,800	2,630
DA	5CW	65-1/4"	22-1/4"	20"	40-1/4"	36"	20"	24"	17"	6,800	3,084
DB	5CX	65-1/4"	22-1/4"	20"	40-1/4"	36"	20"	24"	17"	6,800	3,084
DC	5DA	65-1/4"	22-1/4"	20"	40-1/4"	36"	20"	24"	17"	7,050	3,198
–	5DB	65-1/2"	22-1/4"	20"	40-1/4"	36-1/4"	20"	24"	17"	7,300	3,311
DD	5DC	65-1/2"	22-1/4"	20"	40-1/4"	36-1/4"	20"	24"	17"	7,300	3,311
DE	5DD	65-1/2"	22-1/4"	20"	40-1/4"	36-1/4"	20"	24"	17"	7,300	3,311
DF	5DE	65-1/2"	22-1/4"	20"	40-1/4"	36-1/4"	20"	24"	17"	7,500	3,402
DH	5DF	65-1/2"	22-1/4"	20"	40-1/4"	36-1/4"	20"	24"	17"	7,500	3,402
DJ	5DG	65-1/2"	22-1/4"	20"	40-1/4"	36-1/4"	20"	24"	17"	7,900	3,583
–	5DH	65-1/2"	22-1/4"	20"	40-1/4"	36-1/4"	20"	24"	17"	7,900	3,583
–	5OJ	CONTACT FACTORY FOR DIMENSIONS AND WEIGHTS									

FIG. 32 – TYPICAL DIMENSIONS AND WEIGHTS (CON'T) - STANDARD MOTORS (HIGH VOLTAGE)



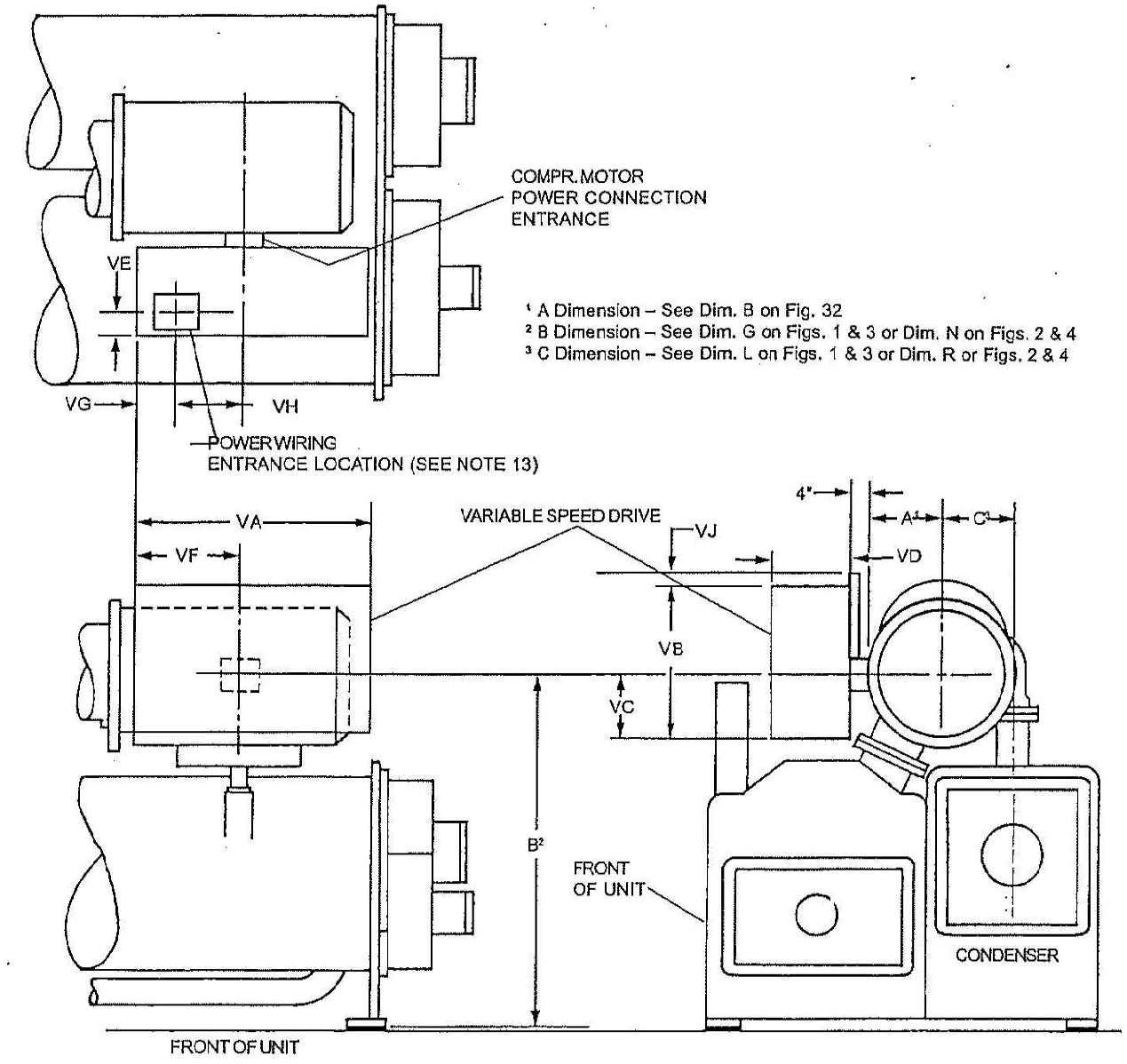
FT. - IN.

Solid State Starter Mod.	SA	SB	SC	SD	SF	SG	SH	WEIGHT (LBS.)
7LK & 14LK	2'–10"	1'–9-3/8"	1'–5"	0'–11"	1'–10"	5-7/16"	1'–4-9/16"	200
26LK & 33LK	2'–11"	2'–1-3/8"	1'–9"	1'	1'–11"	5'-15/16"	1'–5-1/16"	300

mm

Solid State Starter Mod.	SA	SB	SC	SD	SF	SG	SH	WEIGHT (kg)
7LK & 14LK	864	543	432	279	559	138	421	91
26LK & 33LK	889	645	533	305	584	151	433	136

FIG. 37 – SOLID STATE STARTER (OPTION) LOCATION



[1] A Dimension – See Dim. B on Fig. 32
[2] B Dimension – See Dim. G on Figs. 1 & 3 or Dim. N on Figs. 2 & 4
[3] C Dimension – See Dim. L on Figs. 1 & 3 or Dim. R or Figs. 2 & 4

MOTOR SIZE	VA	VB	VC	VD	VE	VF	VG	VH	VJ	WEIGHT (LBS.)
CF - CN, 5CC-5CI	4'–6"	3'–8"	1'–9"	1'–7"	0'–7-7/8"	2'–6"	7-5/8"	1'–10-3/8"	4-1/2"	1,150
CP - CT, 5CJ - 5CM	4'–11"	3'–11"	1'–9"	1'–7"	0'–6-7/8"	2'–11"	8-1/8"	2'–2-7/8"	—	1,300
CU - CZ, 5CN - 5CS	4'–11"	4'–3"	1'–10"	2'–2-3/8"	1'–2-7/8"	3'–0"	9-1/2"	1'–8"	—	2,300

MOTOR SIZE	VA	VB	VC	VD	VE	VF	VG	VH	VJ	WEIGHT (LBS.)
CF - CN, 5CC-5CI	1372	1118	533	483	200	762	194	568	114	520
CP - CT, 5CJ - 5CM	1499	1194	533	483	175	889	206	682	—	590
CU - CZ, 5CN - 5CS	1499	1295	558	670	378	915	241	508	—	1,043

FIG. 38 – VARIABLE SPEED DRIVE (OPTION) LOCATION

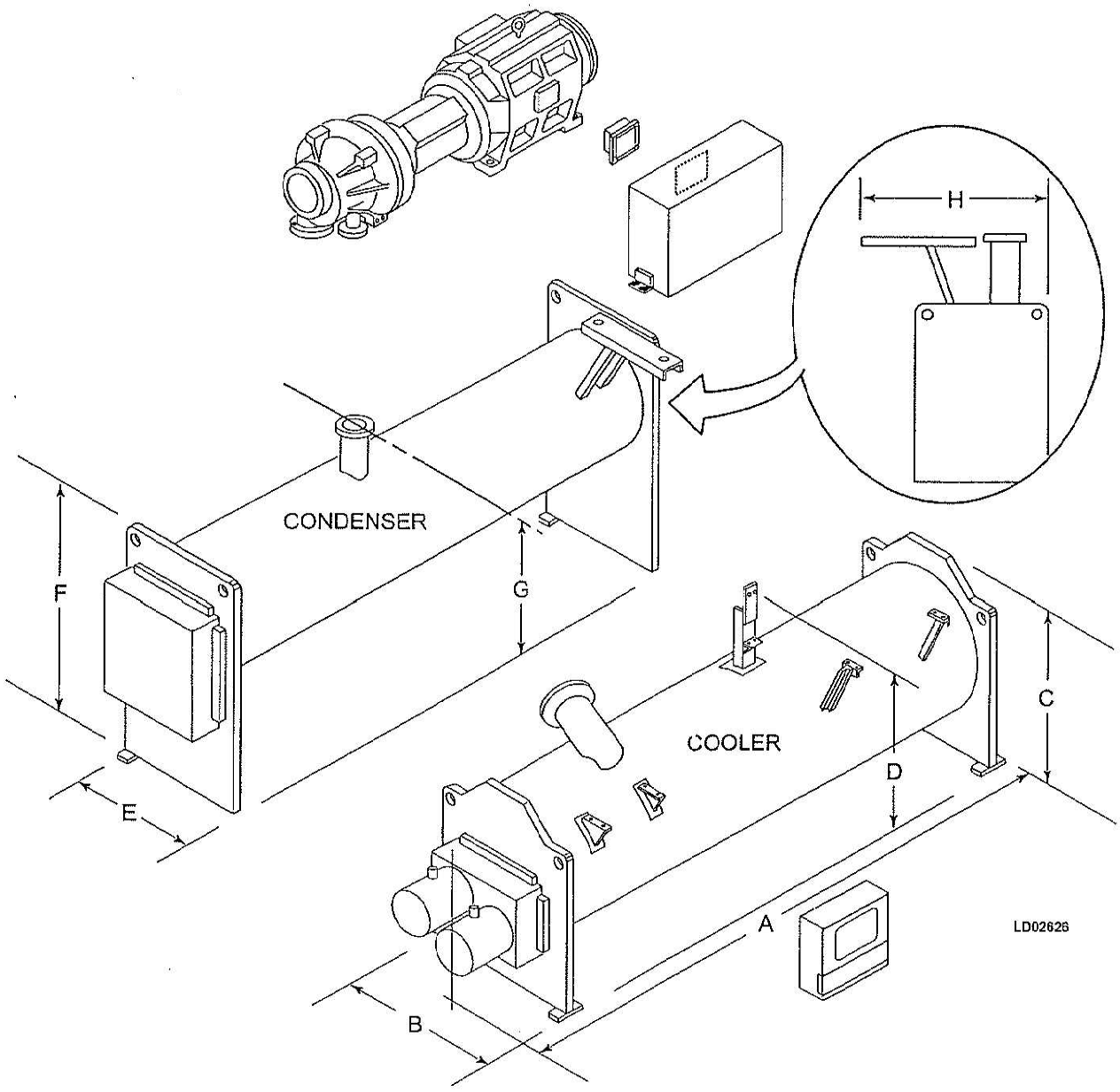


FIG. 41 – FORM 3 & 7 SHIPMENT - G & H COMPRESSOR UNITS (STD. AND METRIC DIMENSIONS)

COOLER DIMENSIONS & SHIPPING WEIGHTS (Standard)

COOLER CODE	A	B	C	D	SHIPPING WT. (LBS.) WITH COMPACT WATER BOXES
C	*	3'–2"	3'–7-3/4"	5'–6-1/2"	7450
D	*	3'–5"	3'–9-1/4"	5'–6-1/2"	8450
E	*	3'–7"	4'–0-1/4"	5'–8-1/2"	9125
F	*	4'–0"	4'–3-1/4"	5'–9"	10,055
G	*	4'–2-1/2"	4'–7-3/4"	5'–11-5/8"	12,400
H	*	4'–6"	4'–10-3/4"	6'–3-3/8"	14,320

* For Dimension "A", refer to Fig. 1 and add water box dimensions from appropriate Figures.

CONDENSER DIMENSIONS & SHIPPING WEIGHTS (Standard)

COND. CODE	E	F	G	H	SHIPPING WT. (LBS.) WITH COMPACT WATER BOXES
C	2'–11"	4'–6-3/4"	4'–11-3/4"	4'–0"	5,600
D	2'–11"	4'–6-3/4"	5'–1-3/4"	4'–0"	6,500
E	2'–11"	4'–9-1/4"	5'–2-1/4"	4'–0"	7,465
F	3'–2"	5'–2-1/4"	5'–4-3/4"	4'–2"	8,825
G	3'–6"	5'–6-1/4"	5'–8-3/4"	4'–4"	11,000

COOLER DIMENSIONS & SHIPPING WEIGHTS (Metric)

COOLER CODE	A	B	C	D	SHIPPING WT. (KG) WITH COMPACT WATER BOXES
C	*	965	1,111	1,689	3,379
D	*	1,041	1,149	1,689	3,833
E	*	1,092	1,226	1,740	4,139
F	*	1,219	1,302	1,753	4,561
G	*	1,283	1,416	1,819	5,624
H	*	1,372	1,492	1,915	6,496

* For Dimension "A", refer to Fig. 3 and add water box dimensions from appropriate Figures.

CONDENSER DIMENSIONS & SHIPPING WEIGHTS (Metric)

COND. CODE	E	F	G	H	SHIPPING WT. (KG) WITH COMPACT WATER BOXES
C	889	1,391	1,518	1,219	2,540
D	889	1,391	1,568	1,219	2,948
E	889	1,454	1,581	1,219	3,386
F	965	1,581	1,645	1,270	4,003
G	1,067	1,988	1,746	1,321	4,990

FIG. 41 – (CONT'D) FORM 3 & 7 SHIPMENT - G & H COMPRESSOR UNITS (STD. AND METRIC DIMENSIONS)

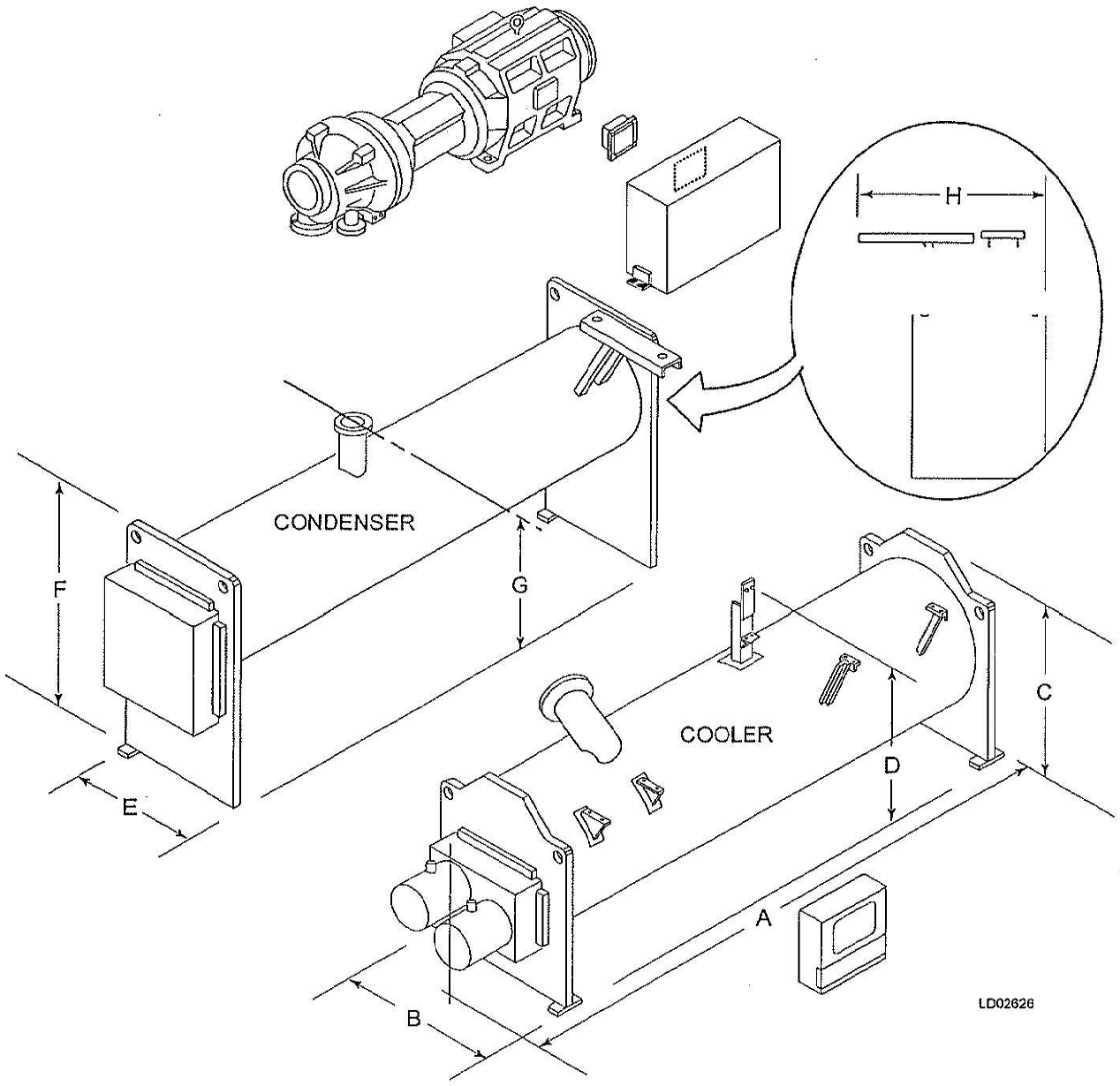


FIG. 42 – FORM 3 & 7 SHIPMENT - J COMPRESSOR UNITS (STD. AND METRIC DIMENSIONS)

COOLER DIMENSIONS & SHIPPING WEIGHTS (Standard)

COOLER CODE	A	B	C	D	SHIPPING WT. (LBS.) WITH COMPACT WATER BOXES
G	*	4'–0"	4'–9-1/4"	5'–6"	10,300
H	*	4'–4-1/2"	5'–1-1/2"	5'–6"	12,560
J	*	4'–11"	5–7-3/4"	6'–0"	15,740
T	*	4'–11"	5'–7-3/4"	6'–0"	17,310
V	*	4'–11"	5'–7-3/4"	6'–0"	18,320
W	*	5'–4"	6'–0-1/4"	7'–2"	22,570

* For Dimension "A", refer to Fig. 2 and add appropriate water box dimensions from appropriate Figures.

CONDENSER DIMENSIONS & SHIPPING WEIGHTS (Standard)

COND. CODE	E	F	G	H	SHIPPING WT. (LBS.) WITH COMPACT WATER BOXES
G	3'–6"	5'–4-1/4"	6'–2-1/4"	4'–9"	11,160
H	3'–10"	5'–5-3/4"	6'–8-1/4"	4'–11"	12,350
J	4'–2"	5'–9-3/4"	6'–8-1/4"	5'–1"	14,490
T	4'–2"	5'–9-3/4"	6'–8-1/4"	5'–1"	16,090
V	4'–7"	6'–2-3/4"	7'–0-1/4"	5'–3-1/2"	19,430

COOLER DIMENSIONS & SHIPPING WEIGHTS (Metric)

COOLER CODE	A	B	C	D	SHIPPING WT. (KG) WITH COMPACT WATER BOXES
G	*	1,219	1,454	1,676	4,672
H	*	1,334	1,562	1,676	5,697
J	*	1,499	1,721	1,829	7,140
T	*	1,499	1,721	1,829	7,852
V	*	1,499	1,721	1,829	8,310
W	*	1,626	1,835	2,184	10,238

* For Dimension "A", refer to Fig. 4 and add appropriate water box dimensions from appropriate Figures.

CONDENSER DIMENSIONS & SHIPPING WEIGHTS (Metric)

COND. CODE	E	F	G	H	SHIPPING WT. (KG) WITH COMPACT WATER BOXES
G	1,067	1,632	1,886	1,448	5,062
H	1,168	1,670	2,038	1,499	5,602
J	1,270	1,772	2,038	1,549	6,573
T	1,270	1,772	2,038	1,549	7,298
V	1,397	1,899	2,140	1,613	8,813

FIG. 42 – (CONT'D)

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☐ REVIEWED ☐ REVISE AND RESUBMIT
☐ REJECTED ☒ FURNISH AS CORRECTED
☐ SUBMIT SPECIFIED ITEM

Corrections or comments made on the shop drawings during this review do not relieve contractor from compliance with requirements of the drawings and specifications. This check is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The contractor is responsible for: confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner.

DIMITRI J. VERVERELLI, INC.
CONSULTING ENGINEERS
PHILADELPHIA, PA.
Date 8/21/00 By WLM

Submittal Data

Purchaser: Stockton Mechanical
700 Burton Ave
Northfield, NJ 08225

Purchase Order:

Project: Delcastle Vo-Tech High School
Wilmington, DE

Engineer: D. J. Ververelli
Philadelphia, PA

Performance: 1081 GPM from 95° F. HW to 85° F. CW at a 78° F. EWB.

Equipment: One Marley Model NC 4221 Series Cooling Towers with the following features

Features: 96" dia. Marley Type H3 Aluminum eight (8) bladed adjustable pitch fan assembly at 463 RPM.

Series 20.1 Type CC-2 Right Angle Geareducer with 3.75/1 ratio. Geareducer is "Maintenance -Free" for five (5) years.

Series 229 Close Coupling.

25 HP, 3/60/208v, 1800 RPM, one speed, one wind, TEFC motor with 1.15 service factor, specifically designed for cooling tower use. Motor is "High Efficiency type for use with a Variable Frequency Drive System.

Marley 15 mil PVC film-type fill (Fire Retardant) MX75-8.1 LE with integral air inlet openings and drift eliminators. Maximum drift rate is 0.005% of circulating flow.

Hot water distribution basin covers.

8" dia. PVC single side inlet piping connection.

RECEIVED
AUG 11 2000
D. J. VERVERELLI, INC.

M 11

Submittal Data (Continued)

Features: 304 SS cold water collection basin Outlet Piping Plan ID1 including 12" dia. bottom outlet connection with anti-cavitation plate and trash screen. 4" dia. ~~combination~~ standpipe overflow and drain connection. SEPARATE

2" ~~X~~" dia. float make-up valve.

One 25 HP 3/60/208v, Square-D Altivar 56 Variable Frequency Drive System w/ manual bypass in a NEMA 1 enclosure. Start up service by Square-D is included. SUBMIT COMPLETE DATA FOR REVIEW.

Cooling tower performance is certified in accordance with CTI Certification Standard STD-201.

Drawings: SB1000FS; SB1000FO; SB1000FG; 97-1477-A; 8839-441-2: 8839-475-2.

Approved For Construction: **Submitted For Approval: XXXX**

The Marley Cooling Tower Company **MARLEY ORDER:**

DATE: July 18, 2000

By: Robert A. Schunke

Robert A. Schunke
Senior Sales Engineer

Attachments

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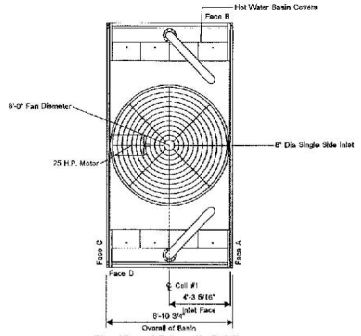


Plan View of Schematic Details

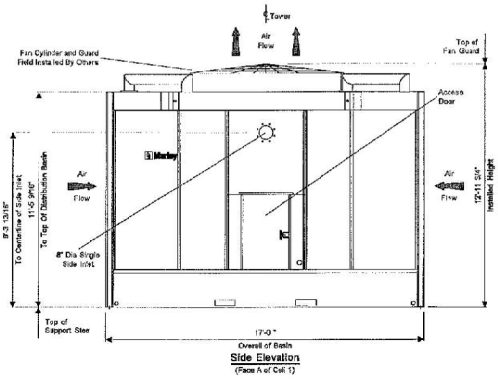
Stockton Mechanical Contractors, Inc.

Approved _____

Approved as noted _____

By HES

Date 8/10/00



Side Elevation
(Face A of Cell 1)

NOTES

- FLANGED CONNECTIONS CONFORM TO CLASS 125 OF THE ANSI B16.1 SPECIFICATION. THE BOLT HOLES STRADDLE THE CENTERLINES.
- THE INLET PIPING, INCLUDING FLAT FACE FLANGE GASKETS, WHICH STARTS AT THE FACE OF THE INLET CONNECTION IS PROVIDED BY MARLEY. THE PIPING EXTERNAL TO THE TOWER AND THEIR SUPPORTS IS PROVIDED BY OTHERS. THE EXTERNAL PIPING MAY NOT BE SUPPORTED FROM THE TOWER.
- THE EXTERNAL INLET PIPING AT THE TOP OF THE TOWER IS PROVIDED BY MARLEY AND INSTALLED IN THE FIELD BY OTHERS. THIS PIPING CAN BE AN OBSTACLE TO PERSONNEL ON TOP OF THE TOWER. THE INSTALLATION DETAIL DRAWINGS ARE INCLUDED IN THE LITERATURE PACKAGE SHIPPED WITH THE TOWER.
- TO INSURE MAXIMUM THERMAL PERFORMANCE THE COOLING TOWER MUST BE INSTALLED LEVEL AND PLUMB. BOTH OF THE AIR INLET FACES MUST HAVE ADEQUATE AIR SUPPLY. IF OBSTRUCTIONS EXIST, CONSULT YOUR MARLEY REPRESENTATIVE.
- ROUTINE MAINTENANCE DOES NOT REQUIRE WORKERS TO USE THE TOP OF THE TOWER AS A WORK PLATFORM. HOT WATER BASIN INSPECTION AND CLEANING CAN BE DONE FROM A PORTABLE LADDER, STAIR, OR SCAFFOLD. MAINTENANCE OF THE MECHANICAL EQUIPMENT CAN BE DONE FROM A PORTABLE LADDER FROM INSIDE THE TOWER. ADEQUATE SAFETY PRECAUTIONS MUST BE TAKEN WHEN USING PORTABLE LADDERS.
- HOISTING CLIPS ARE PROVIDED FOR EASE OF UNLOADING AND POSITIONING. FOR OVERHEAD LIFTS OR WHERE ADDITIONAL SAFETY PRECAUTIONS ARE PRUDENT, ADD SLINGS BENEATH THE TOWER. SEE HOISTING DETAILS DRAWING.
- FOR ADDED SAFETY AND CONVENIENCE DURING MAINTENANCE, MARLEY OFFERS AN OPTIONAL LADDER AND PERIMETER HANDRAIL FOR ACCESS TO THE TOP OF THE TOWER. FOR INTERIOR MAINTENANCE, OPTIONAL INTERNAL WALKWAY(S) ARE ALSO AVAILABLE. DETAIL DRAWINGS FOR THESE AND OTHER NC TOWER OPTIONS ARE AVAILABLE FROM YOUR MARLEY REPRESENTATIVE.
- THE TOWER ASSEMBLY TOLERANCE APPLICABLE TO ALL DIMENSIONS IS + OR - 1/8". CONSULT SUPPLIERS OF SUPPORTING STRUCTURE FOR CONSTRUCTION TOLERANCES.
- THE UNITS OF MEASURE ARE IN I-P (INCH-POUND) UNITS UNLESS OTHERWISE NOTED.

CUSTOMER NAME	PROJECT NAME	ECO NUMBER								
	Delcastle High School	REV BY	CHECKED	Schematic and Inlet Details NC4221					Marley Cooling Tower A United Dominion Company	
TOWER NAME	PROJECT LOCATION	DATE REV.	DRAWN BY	DATE	CHECKED	APPROVED	ORDER NUMBER	PLOT	DRAWING NUMBER	REV.
	Wilmington, DE		Bob Schunke	5/11/2000		SYS		1=1	SB1000FS	

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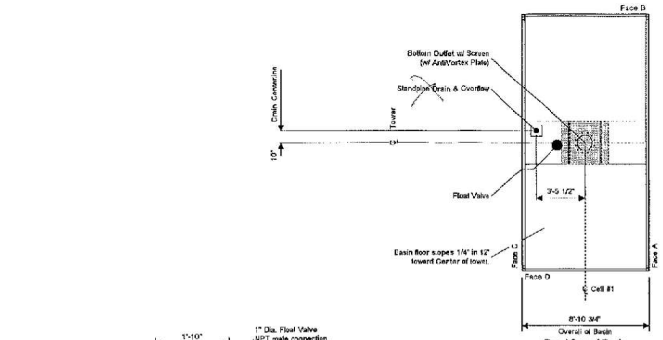
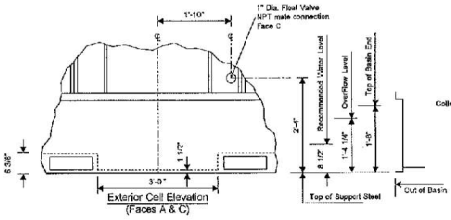
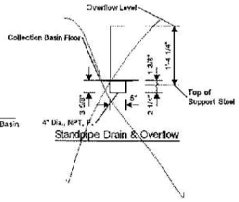


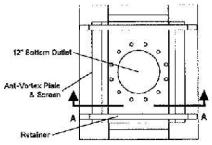
Plan View of Basin



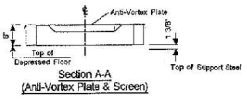
Exterior Cell Elevation (Faces A & C)



Standpipe Drain & Overflow



Bottom Outlet with Anti-Vortex Plate and Screen

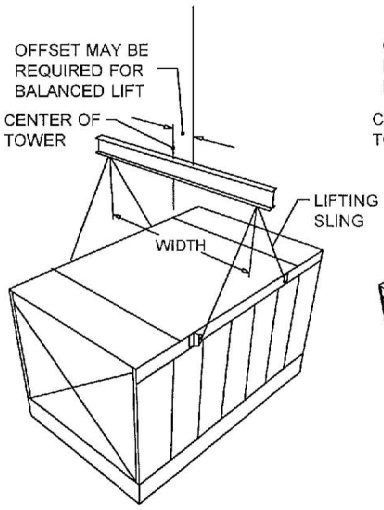


Section A-A (Anti-Vortex Plate & Screen)

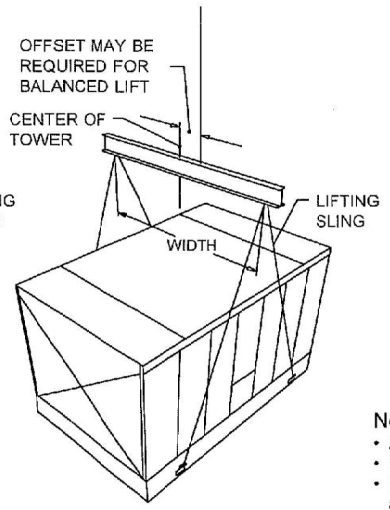
NOTES

- FLANGED CONNECTIONS CONFORM TO CLASS 125 OF THE ANSI B16.1 SPECIFICATION. THE BOLT HOLES STRADDLE THE CENTERLINES.
- ALL PIPING SUPPORTS ARE BY OTHERS. DO NOT SUPPORT OUTLET PIPING FROM THE TOWER.
- SEE THE FLOAT VALVE INFORMATION DRAWING FOR SIZING CRITERIA.
- THE COLLECTION BASIN PIPING ACCESSORIES SHOWN ON THIS DRAWING ARE FURNISHED BY THE MARLEY COOLING TOWER COMPANY. THIS INCLUDES A FULL FACED GASKET, BUT EXCLUDES A FLAT FACED FLANGE ATTACHMENT TO THE OUTLET WHICH IS SUPPLIED BY OTHERS. THE USE OF A FLANGE OTHER THAN A FLAT FACED FLANGE WILL DAMAGE THE SHEET METAL.
- THE INSTALLATION DETAIL DRAWINGS FOR FIELD INSTALLED OPTIONS ARE INCLUDED IN THE LITERATURE PACKAGE SHIPPED WITH THE TOWER.
- THE DESIGN OPERATING LOADS SHOWN IN THE TABLE ON THE "GRILLAGE DETAILS" DRAWING ARE BASED UPON THE VOLUME OF WATER IN THE COLLECTION BASIN AT SHUTDOWN. THE SHUTDOWN WATER LEVEL HAS BEEN SIZED TO ACCOMMODATE THE MAXIMUM ALLOWABLE FLOW RATES. THE ACTUAL OPERATING LOAD IS VARIABLE, AND IS DEPENDENT UPON THE DESIGN FLOW RATE PER CELL. DESIGN LOADS ARE ALL BASED UPON THE RECOMMENDED OPERATING WATER LEVEL. OPERATING LEVELS IN EXCESS OF THAT RECOMMENDED CAN RESULT IN LOADS EXCEEDING VALUES STATED. CONSULT A MARLEY COOLING TOWER SALES ENGINEER FOR GREATER DETAIL ON THIS OR ANY OTHER SUBJECT.
- THE STANDPIPE OVERFLOW IS TO BE FIELD INSTALLED BY OTHERS.
- THE TOWER ASSEMBLY TOLERANCE APPLICABLE TO ALL DIMENSIONS IS + OR - 1/8". CONSULT SUPPLIERS OF SUPPORTING STRUCTURE FOR CONSTRUCTION TOLERANCES.
- THE UNITS OF MEASURE ARE IN-P (INCH-POUND) UNITS UNLESS OTHERWISE NOTED.

CUSTOMER NAME	PROJECT NAME	ECO NUMBER		Outlet Piping Details NC4221						Marley Cooling Tower A United Dominion Company	
	Delcastle High School	REV. BY	CHECKED								
TOWER NAME	PROJECT LOCATION	DATE REV.		DRAWN BY	DATE	CHECKED	APPROVED	ORDER NUMBER	PLOT	DRAWING NUMBER	REV.
	Wilmington, DE			Bob Schunke	5/11/2000		SYS		1=1	SB1000FO	



Tower Units with
Hoisting Clips at the Top
NC1 thru NC7
Top Module NC8, NC9 & NCC



Tower Units with
Hoisting Clips at the Bottom
NC1 thru NC7
Bottom Module NC8, NC9 & NCC

Tower Model	Tower Width	Minimum Sling Length
NC1	6'-6	5'-6
NC2-NC3	8'-0	7'-0
NC4	9'-0	8'-6
NC5	11'-0	8'-6
NC6	12'-0	8'-6
NC7	12'-0	10'-0
NC8 Top	11'-0	10'-0
NC8 Bottom	11'-0	17'-6
NC9 Top	12'-0	10'-0
NC9 Bottom	12'-0	17'-6
NCA	14'-0	17'-5
NCB	14'-0	17'-5
NCC Top	14'-0	10'-0
NCC Bottom	14'-0	17'-6

Notes
- All hoisting clip holes are 1 1/4".
- Overall length of shackle pin should not exceed 5 1/4"
- For overhead lifts or where additional safety is required, add slings beneath the tower unit.

I-P Units

ECO NUMBER		HOISTING DETAILS NC1200 THRU NCC200 TOWERS					Marley Cooling Tower A United Dominion Company		
98-2608									
REV. BY: GM	CHECKED								
DATE REV.	DRAWN BY	DATE	CHECKED	APPROVED	ORDER NUMBER		PLOT	DRAWING NUMBER	REV.
12-14-98	G.L.MILLER	11-11-97		MPC			1=1	97-1477	A

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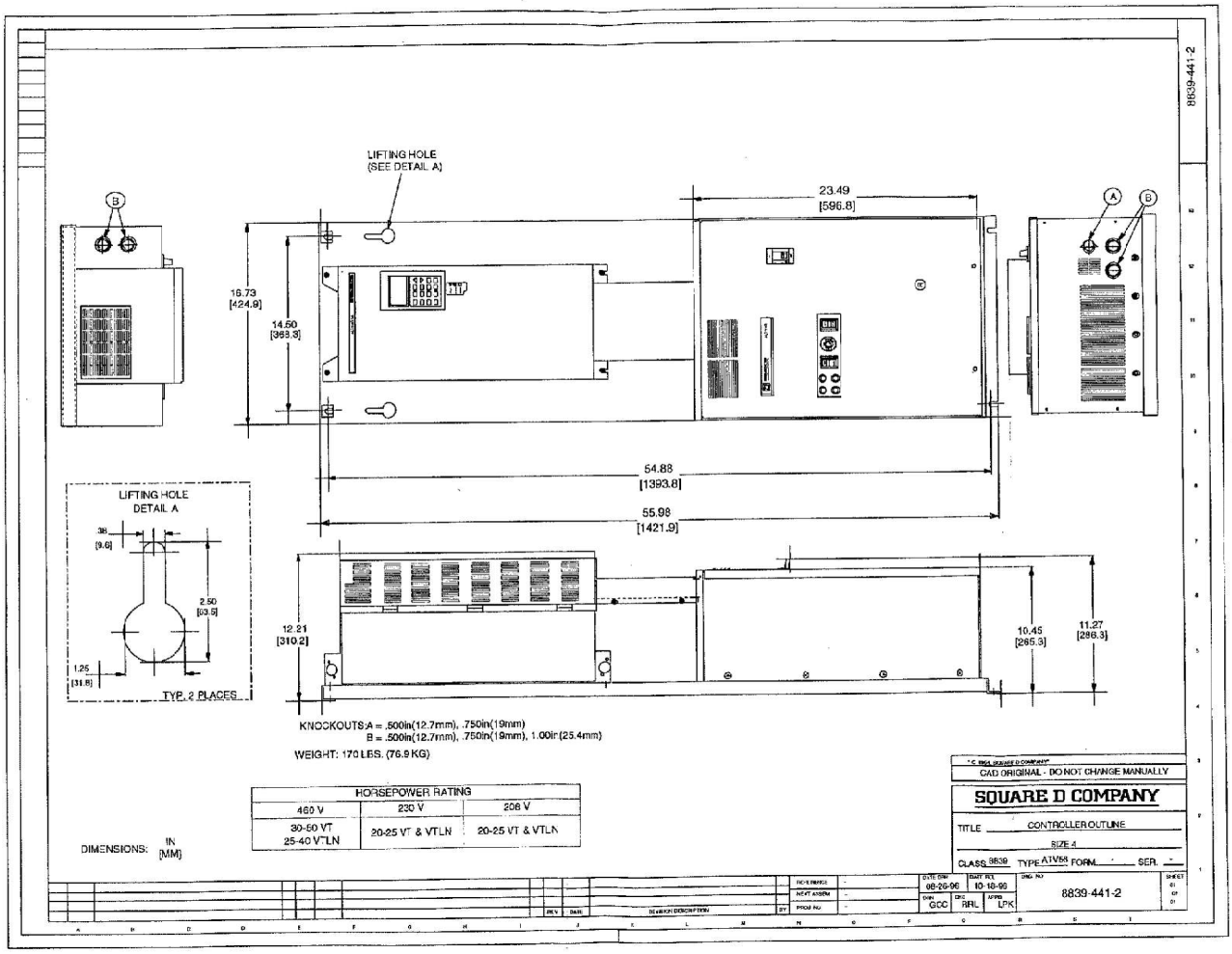
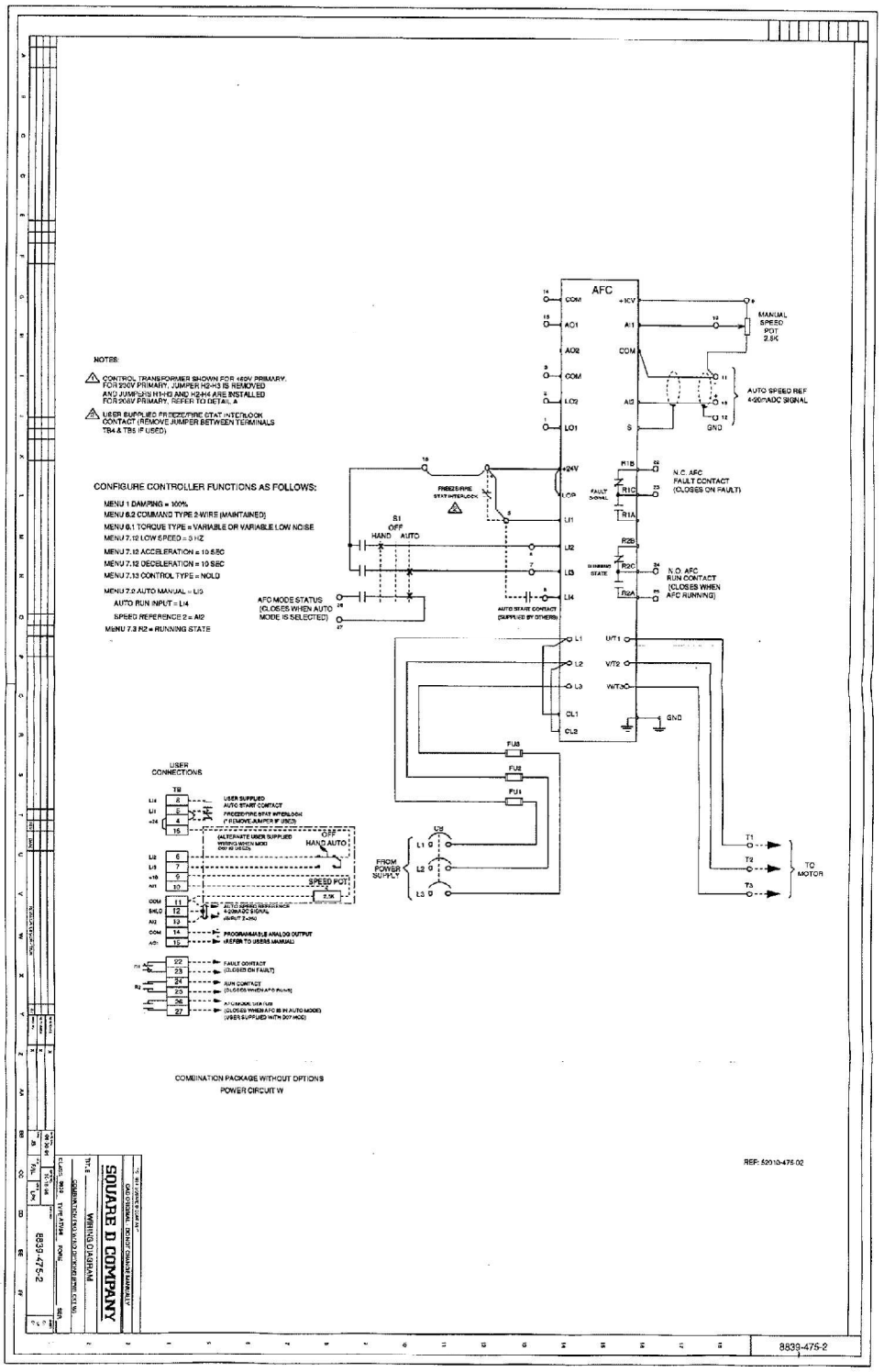

8839-441-2
LIFTING HOLE
(SEE DETAIL A)
23.49
[596.8]
16.73
[424.9]
14.50
[368.3]
54.88
[1393.8]
55.98
[1421.9]
LIFTING HOLE
DETAIL A
.38
[9.6]
2.50
[63.5]
1.25
[31.8]
TYP. 2 PLACES
12.21
[310.2]
10.45
[265.3]
11.27
[286.3]
KNOCKOUTS:A = .500in(12.7mm), .750in(19mm)
B = .500in(12.7mm), .750in(19mm), 1.00in(25.4mm)
WEIGHT: 170 LBS. (76.9 KG)
HORSEPOWER RATING
460 V
230 V
208 V
30-50 VT
25-40 VTLN
20-25 VT & VTLN
20-25 VT & VTLN
DIMENSIONS: IN
[MM]
CAD ORIGINAL - DO NOT CHANGE MANUALLY
SQUARE D COMPANY
TITLE CONTACTOR OUTLINE
SIZE 4
CLASS 8839 TYPE ATVSS FORM SER
DATE DRN 08-26-96
DATE REL 10-16-96
DRN GCC
CHK RRL
APPD LPK
DWG NO 8839-441-2
SHEET 01 OF 01


NOTES:
1. CONTROL TRANSFORMER SHOWN FOR 480V PRIMARY. FOR 230V PRIMARY, JUMPER H2-H3 IS REMOVED AND JUMPERS H1-H3 AND H2-H4 ARE INSTALLED FOR 208V PRIMARY, REFER TO DETAIL A
2. USER SUPPLIED FREEZE/FIRE STAT INTERLOCK CONTACT (REMOVE JUMPER BETWEEN TERMINALS TB4 & TB5 IF USED).
CONFIGURE CONTROLLER FUNCTIONS AS FOLLOWS:
MENU 1 DAMPING = 100%
MENU 6.2 COMMAND TYPE 2-WIRE (MAINTAINED)
MENU 6.1 TORQUE TYPE = VARIABLE OR VARIABLE LOW NOISE
MENU 7.12 LOW SPEED = 0 HZ
MENU 7.10 ACCELERATION = 10 SEC
MENU 7.12 DECELERATION = 10 SEC
MENU 7.13 CONTROL TYPE = NOLD
MENU 7.2 AUTO MANUAL = LI3
AUTO RUN INPUT = LI4
SPEED REFERENCE 2 = AI2
MENU 7.3 R2 = RUNNING STATE
AFC
COM
AO1
AO2
COM
LO2
LO1
+10V
AI1
COM
AI2
S
+24V
LOG
LI1
LI2
LI3
LI4
L1
L2
L3
CL1
CL2
U/T1
V/T2
W/T3
GND
MANUAL SPEED POT 2.5K
AUTO SPEED REF 4-20mADC SIGNAL
R1B
R1C
R1A
N.C. AFC FAULT CONTACT (CLOSES ON FAULT)
R2B
R2C
R2A
N.O. AFC RUN CONTACT (CLOSES WHEN AFC RUNNING)
FREEZE/FIRE STAT INTERLOCK
S1 OFF HAND AUTO
AFC MODE STATUS (CLOSES WHEN AUTO MODE IS SELECTED)
AUTO STATE CONTACT (SUPPLIED BY OTHERS)
FU3
FU2
FU1
L2
FROM POWER SUPPLY
L1
L2
L3
T1
T2
T3
TO MOTOR
USER CONNECTIONS
TB
USER SUPPLIED AUTO START CONTACT
FREEZE/FIRE STAT INTERLOCK (IF REMOVE JUMPER IF USED)
ALTERNATE USER SUPPLIED AUTO/MAN MODE SWITCH (MUST BE USED)
OFF
HAND AUTO
SPEED POT
2.5K
AUTO SPEED REFERENCE 4-20MADC SIGNAL (INPUT 2 only)
PROGRAMMABLE ANALOG OUTPUT (REFER TO USERS MANUAL)
FAULT CONTACT (CLOSES ON FAULT)
RUN CONTACT (CLOSES WHEN AFC RUNS)
AUTO MODE STATUS (CLOSES WHEN AFC IS IN AUTO MODE) (USER SUPPLIED WITH 207 VOLTS)
COMBINATION PACKAGE WITHOUT OPTIONS
POWER CIRCUIT W
REF: 52010-475-02
SQUARE D COMPANY
8839-475-2

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BID FORM

DELCASTLE HIGH SCHOOL CHILLER/COOLING TOWER REFURBISHMENT
WILMINGTON, DELAWARE
CONTRACT NO.: 1907

For Bids Due: _____ **To:** New Castle County Vocational Technical School District
1703 School Lane
Wilmington, DE 19808

Name of Bidder: _____

Delaware Business License No.: _____ **Taxpayer ID No.:** _____
(A copy of Bidder's Delaware Business License must be attached to this form.)

(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 including allowances itemized below:

$_____
($)

ALTERNATES

Alternate prices conform to applicable project specification section. Refer to Division 01 Specification Section "Alternates" for a complete description of the following Alternates. An "ADD" or "DEDUCT" amount is indicated by the crossed out part that does not apply.

ALTERNATE No. 1: COOLING TOWER REFURBISHMENT AND CONDENSER WATER PUMP REPLACEMENT

Add/Deduct: _____
($)

ALLOWANCES

Bidder shall include allowance amount in Base Bid.

Allowances conform to applicable project specification section. Refer to the specifications for a complete description of the following Allowance:

Allowance No. 1: For general contingencies and repairs, the remaining balance of which is to be returned to owner by credit change order at project conclusion. **($20,000.00)**

BID FORM

DELCASTLE HIGH SCHOOL CHILLER/COOLING TOWER REFURBISHMENT
WILMINGTON, DELAWARE
CONTRACT NO.: 1907

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 thirty (30) days from the date of opening of bids (60 days for School Districts and Department of Education), and the undersigned shall abide by the Bid Security forfeiture provisions. Bid Security is attached to this Bid.

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.

Should I/We be awarded this contract, I/We pledge to achieve substantial completion of all the work within _____calendar days of the Notice to Proceed.

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
Affidavit of Employee Drug Testing Program
Bid Security
(Others as Required by Project Manuals)

BID FORM

DELCASTLE HIGH SCHOOL CHILLER/COOLING TOWER REFURBISHMENT
WILMINGTON, DELAWARE
CONTRACT NO.: 1907

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.** This form must be filled out completely with no additions or deletions. Note that all subcontractors listed below must have a signed Affidavit of employee drug testing program included with this bid.

Subcontractor Category	Subcontractor	Address (City & State)	Subcontractors tax payer ID # or Delaware Business license #
1. Electrical			
2. Insulation			
3. Chiller Refurbishment			
4. HVAC Piping			
5. Cooling Tower Refurbishment			
6. ATC Controls			
7. Testing and Balancing			

BID FORM

DELCASTLE HIGH SCHOOL CHILLER/COOLING TOWER REFURBISHMENT
WILMINGTON, DELAWARE
CONTRACT NO.: 1907

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 *(to the Office of Management and Budget, Division of Facilities Management)*.

All the terms and conditions of *(Project or Contract Number)* have been thoroughly examined and are understood.

NAME OF BIDDER: _____

AUTHORIZED REPRESENTATIVE (TYPED): _____

AUTHORIZED REPRESENTATIVE (SIGNATURE): _____

TITLE: _____

ADDRESS OF BIDDER: _____

_____

_____

E-MAIL: _____

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 FORM

DELCASTLE HIGH SCHOOL CHILLER/COOLING TOWER REFURBISHMENT
WILMINGTON, DELAWARE
CONTRACT NO.: 1907

AFFIDAVIT
OF
EMPLOYEE DRUG TESTING PROGRAM

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors implement a program of mandatory drug testing for Employees who work on Large Public Works Contracts funded all or in part with public funds.

We hereby certify that we have in place or will implement during the entire term of the contract a Mandatory Drug Testing Program for our employees on the jobsite, including subcontractors that complies with this regulation:

Contractor/Subcontractor Name: _____

Contractor/Subcontractor Address: _____

_____

_____

Authorized Representative (typed or printed): _____

Authorized Representative (signature): _____

Title: _____

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.
END OF BID FORM

THIS PAGE LEFT INTENTIONALLY BLANK

BID BOND

Bid Bond attached shall be utilized on this project.

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STATE OF DELAWARE - OFFICE OF MANAGEMENT AND BUDGET

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 **State** in the sum of _____ _____ Dollars ($_____), or _____ percent not to exceed _____ _____ Dollars ($_____) of amount of bid on Contract No. _____, to be paid to the **State** for the use and benefit of _____ (***insert State agency name***) 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 bonded **Principal** who has submitted to the _____ (***insert State agency name***) 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 _____ _____ (***insert State agency name***) 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:_____

By: _____

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STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR A101-2017

The contract to be utilized on this project shall be the "Standard Form of Agreement Between Owner and Contractor" AIA Document A101-2017.

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AIA® Document A101™ – 2017

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)

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

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

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

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. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

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

The parties should complete A101™–2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201™–2017, 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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TABLE OF ARTICLES

1 THE CONTRACT DOCUMENTS

2 THE WORK OF THIS CONTRACT

3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

4 CONTRACT SUM

5 PAYMENTS

6 DISPUTE RESOLUTION

7 TERMINATION OR SUSPENSION

8 MISCELLANEOUS PROVISIONS

9 ENUMERATION OF CONTRACT DOCUMENTS

EXHIBIT A INSURANCE AND BONDS

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:
(Check one of the following boxes.)

[ ] The date of this Agreement.

[ ] A date set forth in a notice to proceed issued by the Owner.

[ ] Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

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

§ 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:

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(Check one of the following boxes and complete the necessary information.)

[ ] Not later than ( ) calendar days from the date of commencement of the Work.

[ ] By the following date:

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

Portion of Work	Substantial Completion Date

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

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 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

Item	Price

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.
(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance

§ 4.3 Allowances, if any, included in the Contract Sum:
(Identify each allowance.)

Item	Price

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

Item	Units and Limitations	Price per Unit ($0.00)

§ 4.5 Liquidated damages, if any:
(Insert terms and conditions for liquidated damages, if any.)

§ 4.6 Other:
(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)

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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 amount certified 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 of the amount certified 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 of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 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 In accordance with AIA Document A201™–2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.1 The amount of each progress payment shall first include:

.1 That portion of the Contract Sum properly allocable to completed Work;

.2 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; and

.3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

.1 The aggregate of any amounts previously paid by the Owner;

.2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017;

.3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;

.4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2017; and

.5 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:
(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)

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§ 5.1.7.1.1 The following items are not subject to retainage:
(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:
(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)

§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:
(Insert any other conditions for release of retainage upon Substantial Completion.)

§ 5.1.8 If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.

§ 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 Article 12 of AIA Document A201–2017, 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:

§ 5.3 Interest

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.)

%

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the 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.)

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§ 6.2 Binding Dispute Resolution
For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows:
(Check the appropriate box.)

[ ] Arbitration pursuant to Section 15.4 of AIA Document A201–2017

[ ] Litigation in a court of competent jurisdiction

[ ] Other *(Specify)*

If the Owner and Contractor do not select a method of binding dispute resolution, 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.

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 A201–2017.

§ 7.1.1 If the Contract is terminated for the Owner's convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows:
(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner's convenience.)

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017.

ARTICLE 8 MISCELLANEOUS PROVISIONS
§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

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

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

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

§ 8.5 Insurance and Bonds

§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A101™–2017 Exhibit A, and elsewhere in the Contract Documents.

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:
(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

§ 8.7 Other provisions:

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

.1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor
.2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds
.3 AIA Document A201™–2017, General Conditions of the Contract for Construction
.4 AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:
(Insert the date of the E203-2013 incorporated into this Agreement.)

.5 Drawings

Number	Title	Date

.6 Specifications

Section	Title	Date	Pages

.7 Addenda, if any:

Number	Date	Pages

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

.8 Other Exhibits:
(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

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[ ] AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:
(Insert the date of the E204-2017 incorporated into this Agreement.)

[ ] The Sustainability Plan:

Title	Date	Pages

[ ] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

.9 Other documents, if any, listed below:
(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™–2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)

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)*

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AIA® Document A101™ – 2017 Exhibit A

Insurance and Bonds

This Insurance and Bonds Exhibit is part of the Agreement, between the Owner and the Contractor, dated the day of in the year
(In words, indicate day, month and year.)

for the following **PROJECT:**
(Name and location or address)

THE OWNER:
(Name, legal status and address)

THE CONTRACTOR:
(Name, legal status and address)

TABLE OF ARTICLES

A.1 GENERAL

A.2 OWNER'S INSURANCE

A.3 CONTRACTOR'S INSURANCE AND BONDS

A.4 SPECIAL TERMS AND CONDITIONS

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. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

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

This document is intended to be used in conjunction with AIA Document A201™–2017, General Conditions of the Contract for Construction. Article 11 of A201™–2017 contains additional insurance provisions.

ARTICLE A.1 GENERAL

The Owner and Contractor shall purchase and maintain insurance, and provide bonds, as set forth in this Exhibit. As used in this Exhibit, the term General Conditions refers to AIA Document A201™–2017, General Conditions of the Contract for Construction.

ARTICLE A.2 OWNER'S INSURANCE

§ A.2.1 General

Prior to commencement of the Work, the Owner shall secure the insurance, and provide evidence of the coverage, required under this Article A.2 and, upon the Contractor's request, provide a copy of the property insurance policy or policies required by Section A.2.3. The copy of the policy or policies provided shall contain all applicable conditions, definitions, exclusions, and endorsements.

§ A.2.2 Liability Insurance

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

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§ A.2.3 Required Property Insurance

§ A.2.3.1 Unless this obligation is placed on the Contractor pursuant to Section A.3.3.2.1, the Owner shall purchase and maintain, from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located, property insurance written on a builder's risk "all-risks" completed value or equivalent policy form and sufficient to cover the total value of the entire Project on a replacement cost basis. The Owner's property insurance coverage shall be no less than the amount of the initial Contract Sum, plus the value of subsequent Modifications and labor performed and materials or equipment supplied by others. The property insurance shall be maintained until Substantial Completion and thereafter as provided in Section A.2.3.1.3, unless otherwise provided in the Contract Documents or otherwise agreed in writing by the parties to this Agreement. This insurance shall include the interests of the Owner, Contractor, Subcontractors, and Sub-subcontractors in the Project as insureds. This insurance shall include the interests of mortgagees as loss payees.

§ A.2.3.1.1 Causes of Loss. The insurance required by this Section A.2.3.1 shall provide coverage for direct physical loss or damage, and shall not exclude the risks of fire, explosion, theft, vandalism, malicious mischief, collapse, earthquake, flood, or windstorm. The insurance shall also provide coverage for ensuing loss or resulting damage from error, omission, or deficiency in construction methods, design, specifications, workmanship, or materials. Sub-limits, if any, are as follows:
(Indicate below the cause of loss and any applicable sub-limit.)

Causes of Loss	Sub-Limit

§ A.2.3.1.2 Specific Required Coverages. The insurance required by this Section A.2.3.1 shall provide coverage for loss or damage to falsework and other temporary structures, and to building systems from testing and startup. The insurance shall also cover debris removal, including demolition occasioned by enforcement of any applicable legal requirements, and reasonable compensation for the Architect's and Contractor's services and expenses required as a result of such insured loss, including claim preparation expenses. Sub-limits, if any, are as follows:
(Indicate below type of coverage and any applicable sub-limit for specific required coverages.)

Coverage	Sub-Limit

§ A.2.3.1.3 Unless the parties agree otherwise, upon Substantial Completion, the Owner shall continue the insurance required by Section A.2.3.1 or, if necessary, replace the insurance policy required under Section A.2.3.1 with property insurance written for the total value of the Project that shall remain in effect until expiration of the period for correction of the Work set forth in Section 12.2.2 of the General Conditions.

§ A.2.3.1.4 Deductibles and Self-Insured Retentions. If the insurance required by this Section A.2.3 is subject to deductibles or self-insured retentions, the Owner shall be responsible for all loss not covered because of such deductibles or retentions.

§ A.2.3.2 Occupancy or Use Prior to Substantial Completion. The Owner's occupancy or use of any completed or partially completed portion of the Work prior to Substantial Completion shall not commence until the insurance company or companies providing the insurance under Section A.2.3.1 have consented in writing to the continuance of coverage. The Owner and the Contractor shall take no action with respect to partial occupancy or use that would cause cancellation, lapse, or reduction of insurance, unless they agree otherwise in writing.

§ A.2.3.3 Insurance for Existing Structures

If the Work involves remodeling an existing structure or constructing an addition to an existing structure, the Owner shall purchase and maintain, until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, "all-risks" property insurance, on a replacement cost basis, protecting the existing structure against direct physical loss or damage from the causes of loss identified in Section A.2.3.1, notwithstanding the undertaking of the Work. The Owner shall be responsible for all co-insurance penalties.

§ A.2.4 Optional Extended Property Insurance.

The Owner shall purchase and maintain the insurance selected and described below.
(Select the types of insurance the Owner is required to purchase and maintain by placing an X in the box(es) next to

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the description(s) of selected insurance. For each type of insurance selected, indicate applicable limits of coverage or other conditions in the fill point below the selected item.)

[ ] § A.2.4.1 **Loss of Use, Business Interruption, and Delay in Completion Insurance**, to reimburse the Owner for loss of use of the Owner's property, or the inability to conduct normal operations due to a covered cause of loss.

[ ] § A.2.4.2 **Ordinance or Law Insurance**, for the reasonable and necessary costs to satisfy the minimum requirements of the enforcement of any law or ordinance regulating the demolition, construction, repair, replacement or use of the Project.

[ ] § A.2.4.3 **Expediting Cost Insurance**, for the reasonable and necessary costs for the temporary repair of damage to insured property, and to expedite the permanent repair or replacement of the damaged property.

[ ] § A.2.4.4 **Extra Expense Insurance**, to provide reimbursement of the reasonable and necessary excess costs incurred during the period of restoration or repair of the damaged property that are over and above the total costs that would normally have been incurred during the same period of time had no loss or damage occurred.

[ ] § A.2.4.5 **Civil Authority Insurance**, for losses or costs arising from an order of a civil authority prohibiting access to the Project, provided such order is the direct result of physical damage covered under the required property insurance.

[ ] § A.2.4.6 **Ingress/Egress Insurance**, for loss due to the necessary interruption of the insured's business due to physical prevention of ingress to, or egress from, the Project as a direct result of physical damage.

[ ] § A.2.4.7 **Soft Costs Insurance**, to reimburse the Owner for costs due to the delay of completion of the Work, arising out of physical loss or damage covered by the required property insurance: including construction loan fees; leasing and marketing expenses; additional fees, including those of architects, engineers, consultants, attorneys and accountants, needed for the completion of the construction, repairs, or reconstruction; and carrying costs such as property taxes, building permits, additional interest on loans, realty taxes, and insurance premiums over and above normal expenses.

§ A.2.5 Other Optional Insurance.

The Owner shall purchase and maintain the insurance selected below.

(Select the types of insurance the Owner is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance.)

[ ] § A.2.5.1 **Cyber Security Insurance** for loss to the Owner due to data security and privacy breach, including costs of investigating a potential or actual breach of confidential or private information. *(Indicate applicable limits of coverage or other conditions in the fill point below.)*

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[ ] § A.2.5.2 Other Insurance

(List below any other insurance coverage to be provided by the Owner and any applicable limits.)

Coverage	Limits

ARTICLE A.3 CONTRACTOR'S INSURANCE AND BONDS

§ A.3.1 General

§ A.3.1.1 Certificates of Insurance. The Contractor shall provide certificates of insurance acceptable to the Owner evidencing compliance with the requirements in this Article A.3 at the following times: (1) prior to commencement of the Work; (2) upon renewal or replacement of each required policy of insurance; and (3) upon the Owner's written request. An additional certificate evidencing continuation of commercial liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment and thereafter upon renewal or replacement of such coverage until the expiration of the periods required by Section A.3.2.1 and Section A.3.3.1. The certificates will show the Owner as an additional insured on the Contractor's Commercial General Liability and excess or umbrella liability policy or policies.

§ A.3.1.2 Deductibles and Self-Insured Retentions. The Contractor shall disclose to the Owner any deductible or self-insured retentions applicable to any insurance required to be provided by the Contractor.

§ A.3.1.3 Additional Insured Obligations. To the fullest extent permitted by law, the Contractor shall cause the commercial general liability coverage 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 for which loss occurs during completed operations. The additional insured coverage shall be primary and non-contributory to any of the Owner's general liability insurance policies and shall apply to both ongoing and completed operations. To the extent commercially available, the additional insured coverage shall be no less than that provided by Insurance Services Office, Inc. (ISO) forms CG 20 10 07 04, CG 20 37 07 04, and, with respect to the Architect and the Architect's consultants, CG 20 32 07 04.

§ A.3.2 Contractor's Required Insurance Coverage

§ A.3.2.1 The Contractor shall purchase and maintain the following types and limits of insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, unless a different duration is stated below:
(If the Contractor is required to maintain insurance for a duration other than the expiration of the period for correction of Work, state the duration.)

§ A.3.2.2 Commercial General Liability

§ A.3.2.2.1 Commercial General Liability insurance for the Project written on an occurrence form with policy limits of not less than ($) each occurrence, ($) general aggregate, and ($) aggregate for products-completed operations hazard, providing coverage for claims including

.1 damages because of bodily injury, sickness or disease, including occupational sickness or disease, and death of any person;
.2 personal injury and advertising injury;
.3 damages because of physical damage to or destruction of tangible property, including the loss of use of such property;
.4 bodily injury or property damage arising out of completed operations; and
.5 the Contractor's indemnity obligations under Section 3.18 of the General Conditions.

§ A.3.2.2.2 The Contractor's Commercial General Liability policy under this Section A.3.2.2 shall not contain an exclusion or restriction of coverage for the following:

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.1 Claims by one insured against another insured, if the exclusion or restriction is based solely on the fact that the claimant is an insured, and there would otherwise be coverage for the claim.

.2 Claims for property damage to the Contractor's Work arising out of the products-completed operations hazard where the damaged Work or the Work out of which the damage arises was performed by a Subcontractor.

.3 Claims for bodily injury other than to employees of the insured.

.4 Claims for indemnity under Section 3.18 of the General Conditions arising out of injury to employees of the insured.

.5 Claims or loss excluded under a prior work endorsement or other similar exclusionary language.

.6 Claims or loss due to physical damage under a prior injury endorsement or similar exclusionary language.

.7 Claims related to residential, multi-family, or other habitational projects, if the Work is to be performed on such a project.

.8 Claims related to roofing, if the Work involves roofing.

.9 Claims related to exterior insulation finish systems (EIFS), synthetic stucco or similar exterior coatings or surfaces, if the Work involves such coatings or surfaces.

.10 Claims related to earth subsidence or movement, where the Work involves such hazards.

.11 Claims related to explosion, collapse and underground hazards, where the Work involves such hazards.

§ A.3.2.3 Automobile Liability covering vehicles owned, and non-owned vehicles used, by the Contractor, with policy limits of not less than ($) per accident, for bodily injury, death of any person, and property damage arising out of the ownership, maintenance and use of those motor vehicles along with any other statutorily required automobile coverage.

§ A.3.2.4 The Contractor may achieve the required limits and coverage for Commercial General Liability and Automobile Liability through a combination of primary and excess or umbrella liability insurance, provided such primary and excess or umbrella insurance policies result in the same or greater coverage as the coverages required under Section A.3.2.2 and A.3.2.3, and in no event shall any excess or umbrella liability insurance provide narrower coverage than the primary policy. The excess policy shall not require the exhaustion of the underlying limits only through the actual payment by the underlying insurers.

§ A.3.2.5 Workers' Compensation at statutory limits.

§ A.3.2.6 Employers' Liability with policy limits not less than ($) each accident, ($) each employee, and ($) policy limit.

§ A.3.2.7 Jones Act, and the Longshore & Harbor Workers' Compensation Act, as required, if the Work involves hazards arising from work on or near navigable waterways, including vessels and docks

§ A.3.2.8 If the Contractor is required to furnish professional services as part of the Work, the Contractor shall procure Professional Liability insurance covering performance of the professional services, with policy limits of not less than ($) per claim and ($) in the aggregate.

§ A.3.2.9 If the Work involves the transport, dissemination, use, or release of pollutants, the Contractor shall procure Pollution Liability insurance, with policy limits of not less than ($) per claim and ($) in the aggregate.

§ A.3.2.10 Coverage under Sections A.3.2.8 and A.3.2.9 may be procured through a Combined Professional Liability and Pollution Liability insurance policy, with combined policy limits of not less than ($) per claim and ($) in the aggregate.

§ A.3.2.11 Insurance for maritime liability risks associated with the operation of a vessel, if the Work requires such activities, with policy limits of not less than ($) per claim and ($) in the aggregate.

§ A.3.2.12 Insurance for the use or operation of manned or unmanned aircraft, if the Work requires such activities, with policy limits of not less than ($) per claim and ($) in the aggregate.

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§ A.3.3 Contractor's Other Insurance Coverage

§ A.3.3.1 Insurance selected and described in this Section A.3.3 shall be purchased from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, unless a different duration is stated below:
(If the Contractor is required to maintain any of the types of insurance selected below for a duration other than the expiration of the period for correction of Work, state the duration.)

§ A.3.3.2 The Contractor shall purchase and maintain the following types and limits of insurance in accordance with Section A.3.3.1.
(Select the types of insurance the Contractor is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance. Where policy limits are provided, include the policy limit in the appropriate fill point.)

[ ] **§ A.3.3.2.1** Property insurance of the same type and scope satisfying the requirements identified in Section A.2.3, which, if selected in this section A.3.3.2.1, relieves the Owner of the responsibility to purchase and maintain such insurance except insurance required by Section A.2.3.1.3 and Section A.2.3.3. The Contractor shall comply with all obligations of the Owner under Section A.2.3 except to the extent provided below. The Contractor shall disclose to the Owner the amount of any deductible, and the Owner shall be responsible for losses within the deductible. Upon request, the Contractor shall provide the Owner with a copy of the property insurance policy or policies required. The Owner shall adjust and settle the loss with the insurer and be the trustee of the proceeds of the property insurance in accordance with Article 11 of the General Conditions unless otherwise set forth below:
(Where the Contractor's obligation to provide property insurance differs from the Owner's obligations as described under Section A.2.3, indicate such differences in the space below. Additionally, if a party other than the Owner will be responsible for adjusting and settling a loss with the insurer and acting as the trustee of the proceeds of property insurance in accordance with Article 11 of the General Conditions, indicate the responsible party below.)

[ ] **§ A.3.3.2.2 Railroad Protective Liability Insurance**, with policy limits of not less than ($) per claim and ($) in the aggregate, for Work within fifty (50) feet of railroad property.

[ ] **§ A.3.3.2.3 Asbestos Abatement Liability Insurance**, with policy limits of not less than ($) per claim and ($) in the aggregate, for liability arising from the encapsulation, removal, handling, storage, transportation, and disposal of asbestos-containing materials.

[ ] **§ A.3.3.2.4** Insurance for physical damage to property while it is in storage and in transit to the construction site on an "all-risks" completed value form.

[ ] **§ A.3.3.2.5** Property insurance on an "all-risks" completed value form, covering property owned by the Contractor and used on the Project, including scaffolding and other equipment.

[ ] **§ A.3.3.2.6 Other Insurance**
(List below any other insurance coverage to be provided by the Contractor and any applicable limits.)

Coverage	Limits

§ A.3.4 Performance Bond and Payment Bond

The Contractor shall provide surety bonds, from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located, as follows:
(Specify type and penal sum of bonds.)

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Type	Penal Sum ($0.00)
Payment Bond	
Performance Bond	

Payment and Performance Bonds shall be AIA Document A312™, Payment Bond and Performance Bond, or contain provisions identical to AIA Document A312™, current as of the date of this Agreement.

ARTICLE A.4 SPECIAL TERMS AND CONDITIONS

Special terms and conditions that modify this Insurance and Bonds Exhibit, if any, are as follows:

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Additions and Deletions Report for

AIA® Document A101™ – 2017 Exhibit A

This Additions and Deletions Report, as defined on page 1 of the associated document, reproduces below all text the author has added to the standard form AIA document in order to complete it, as well as any text the author may have added to or deleted from the original AIA text. Added text is shown underlined. Deleted text is indicated with a horizontal line through the original AIA text.

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SECTION 00 54 13
SUPPLEMENT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR A101-2017

The following supplements modify the "Standard Form of Agreement Between Owner and Contractor," AIA Document A101-2017. Where a portion of the Standard Form of Agreement is modified or deleted by the following, the unaltered portions of the Standard Form of Agreement shall remain in effect.

ARTICLE 5: PAYMENTS

5.1 PROGRESS PAYMENTS

5.1.3 Delete paragraph 5.1.3 in its entirety and replace with the following:

"Provided that a valid Application for Payment is received by the Engineer that meets all requirements of the Contract, payment shall be made by the Owner not later than 30 days after the Owner receives the valid Application for Payment."

ARTICLE 6: DISPUTE RESOLUTION

6.2 BINDING DISPUTE RESOLUTION

Check Other – and add the following sentence:

"Any remedies available in law or in equity."

ARTICLE 8: MISCELLANEOUS PROVISIONS

8.2 Insert the following:

"Payments are due 30 days after receipt of a valid Application for Payment. After that 30 day period, interest may be charged at the rate of 1% per month not to exceed 12% per annum."

8.5 Delete paragraph 8.5 in its entirety and replace with the following:

"The Contractor's representative shall not be changed without ten days written notice to the Owner."

END OF SUPPLEMENT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR

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PERFORMANCE BOND

Performance Bond attached shall be utilized on this project.

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PERFORMANCE BOND

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

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 _____ ("**Owner**") (***insert State agency name***), 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 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, 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, 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)

PAYMENT BOND

Payment Bond attached shall be utilized on this project.

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PAYMENT BOND

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

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 _____ ("**Owner**") (***insert State agency name***), 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 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, 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, 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, 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)

SUBMITTAL TRANSMITTAL FORM – CSI FORM 12.1A

Submittal Transmittal Form attached shall be utilized on this project.

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Advancement of Construction Technology

SUBMITTAL TRANSMITTAL

Project: _____ Date: _____

_____ A/E Project Number: _____

TRANSMITTAL A To (Contractor): _____ Date: _____ Submittal No. _____

From (Subcontractor): _____ By: _____ ☐ Resubmission

Qty.	Reference / Number	Title / Description / Manufacturer	Spec. Section Title and Paragraph / Drawing Detail Reference

☐ Submitted for review and approval
☐ Resubmitted for review and approval
☐ Complies with contract requirements
☐ Will be available to meet construction schedule
☐ A/E review time included in construction schedule

☐ Substitution involved - Substitution request attached
☐ If substitution involved, submission includes point-by-point comparative data or preliminary details
☐ Items included in submission will be ordered immediately upon receipt of approval

Other remarks on above submission: ☐ One copy retained by sender

TRANSMITTAL B To (A/E): _____ Attn: _____ Date Rec'd by Contractor: _____

From (Contractor): _____ By: _____ Date Trnsmt'd by Contractor: _____

☐ Approved
☐ Approved as noted

☐ Revise / Resubmit
☐ Rejected / Resubmit

Other remarks on above submission: ☐ One copy retained by sender

TRANSMITTAL C To (Contractor): _____ Attn: _____ Date Rec'd by A/E: _____

From (A/E): _____ ☐ Other By: _____ Date Trnsmt'd by A/E: _____

☐ Approved
☐ Approved as noted
☐ Not subject to review
☐ No action required
☐ Revise / Resubmit
☐ Rejected / Resubmit
☐ Approved as noted / Resubmit

☐ Provide file copy with corrections identified
☐ Sepia copies only returned
☐ Point-by-point comparative data required to complete approval process
☐ Submission Incomplete / Resubmit

Other remarks on above submission: ☐ One copy retained by sender

TRANSMITTAL D To (Subcontractor): _____ Attn: _____ Date Rec'd by Contractor: _____

From (Contractor): _____ By: _____ Date Trnsmt'd by Contractor: _____

Copies: ☐ Owner ☐ Consultants ☐ _____ ☐ _____ ☐ _____ ☐ One copy retained by sender

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September 1996
CSI Form 12.1A

SCHEDULE OF VALUES FORM – AIA DOCUMENT G703-1992

Schedules of Values Form attached shall be utilized on this project.

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AIA® Document G703™ – 1992

Continuation Sheet

AIA Document, G702™–1992, Application and Certification for Payment, or G736™–2009, Project Application and Project Certificate for Payment, Construction Manager as Adviser Edition, containing Contractor's signed certification is attached.
In tabulations below, amounts are in US dollars.
Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NO:	001
APPLICATION DATE:	
PERIOD TO:	
ARCHITECT'S PROJECT NO:	

A	B	C	D	E	F	G		H	I
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	WORK COMPLETED		MATERIALS PRESENTLY STORED (NOT IN D OR E)	TOTAL COMPLETED AND STORED TO DATE (D + E + F)	% (G ÷ C)	BALANCE TO FINISH (C - G)	RETAINAGE (IF VARIABLE RATE)
			FROM PREVIOUS APPLICATION (D + E)	THIS PERIOD					
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
	GRAND TOTAL	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**0.00%**	**$0.00**	**$0.00**

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APPLICATION AND CERTIFICATE FOR PAYMENT FORM – AIA DOCUMENT G702-1992

Application and Certificate for Payment Form attached herein shall be utilized on this project.

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AIA® Document G702™ – 1992

Application and Certificate for Payment

TO OWNER:	**PROJECT:**	**APPLICATION NO:** 001	**Distribution to:**
		PERIOD TO:	OWNER: ☐
FROM CONTRACTOR:	**VIA ARCHITECT:**	**CONTRACT FOR:** General Construction	ARCHITECT: ☐
		CONTRACT DATE:	CONTRACTOR: ☐
		PROJECT NOS: / /	FIELD: ☐
			OTHER: ☐

CONTRACTOR'S APPLICATION FOR PAYMENT

Application is made for payment, as shown below, in connection with the Contract.
Continuation Sheet, AIA Document G703, is attached.

1. ORIGINAL CONTRACT SUM		$0.00
2. NET CHANGE BY CHANGE ORDERS		$0.00
3. CONTRACT SUM TO DATE (Line 1 ± 2)		$0.00
4. TOTAL COMPLETED & STORED TO DATE (Column G on G703)		$0.00
5. RETAINAGE:		
a. 0 % of Completed Work (Column D + E on G703)	$0.00	
b. 0 % of Stored Material (Column F on G703)	$0.00	
Total Retainage (Lines 5a + 5b or Total in Column I of G703)		$0.00
6. TOTAL EARNED LESS RETAINAGE (Line 4 Less Line 5 Total)		$0.00
7. LESS PREVIOUS CERTIFICATES FOR PAYMENT (Line 6 from prior Certificate)		$0.00
8. CURRENT PAYMENT DUE		$0.00
9. BALANCE TO FINISH, INCLUDING RETAINAGE (Line 3 less Line 6)	$0.00	

CHANGE ORDER SUMMARY	ADDITIONS	DEDUCTIONS
Total changes approved in previous months by Owner	$0.00	$0.00
Total approved this Month	$0.00	$0.00
TOTALS	$0.00	$0.00
NET CHANGES by Change Order		$0.00

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

CONTRACTOR:

By: _____ Date: _____

State of:

County of:

Subscribed and sworn to before me this day of

Notary Public:

My Commission expires:

ARCHITECT'S CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on on-site observations and the data comprising this application, the Architect certifies to the Owner that to the best of the Architect's knowledge, information and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the AMOUNT CERTIFIED.

AMOUNT CERTIFIED $0.00

(Attach explanation if amount certified differs from the amount applied. Initial all figures on this Application and on the Continuation Sheet that are changed to conform with the amount certified.)

ARCHITECT:

By: _____ Date: _____

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract.

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CAD FILE RELEASE FORM

CAD File Release Form attached shall be utilized on this project.

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Gipe Associates, Inc.
CONSULTING ENGINEERS

RELEASE OF ELECTRONIC MEDIA (DRAWINGS, SPECIFICATIONS, ETC.)

PROJECT:_____ DATE:_____

PROJECT NO:_____ RECORD DOCUMENT DATE _____

In accepting and utilizing any drawings or other data on any form of electronic media generated and provided by Gipe Associates, Inc., the Owner, its agents, other design professionals, or contractors covenants and agrees that all such drawings and data are instruments of service of Gipe Associates, Inc., and its Consultants (hereinafter referred to as the Engineer), who shall be deemed the author of the drawings and data, and shall retain all common law, statutory law and other rights, including copyrights.

For documentation purposes, the original electronic media (disks) will be retained by the Engineer, and both parties acknowledge that the referenced, dated Record Document is the actual contract deliverable. The Owner shall be permitted to retain copies of Drawings and Specifications prepared in electronic form for the Owner's convenience in connection with the specific project for which this information was prepared. Due to the potential that the information set forth on the electronic media can be modified, unintentionally or otherwise, the Engineer reserves the right to remove all indicia of its ownership and/or involvement from each document on the electronic media.

No warranty is made or implied as to the suitability of these files or the information they contain for such purpose. In all cases, the Contract Drawings and Specifications shall define all requirements. The Contractor is responsible for verification of Drawings and field conditions and/recognizing the impermanence and changeability of electronic files, assumes all responsibility for their use and alteration.

The Owner, its Agents or other design professionals further agree not to use these drawings and data, in whole or in part, for any purpose or project other than the project which is the subject of this Agreement. The Owner, its Agents, other design professionals, or contractors agree to waive all claims against the Engineer, and to the fullest extent permitted by law, to indemnify and hold the Engineer harmless from any damage, liability or cost, including reasonable attorneys' fees and cost of defense, arising from any changes or use of the Drawings and data made by anyone other than the Engineer without the prior written consent of the Engineer. Any such unauthorized use or reuse will be at the Owner's sole risk and without liability or legal exposure to the Engineer.

Under no circumstances shall transfer of the Drawings and other instruments of service on electronic media for use by the Owner, its Agents or other design professionals be deemed a sale by the Engineer, and the Engineer makes no warranties, either express or implied, of merchantability and fitness for any particular purpose.

_____
Accepted - Owner or Owner's Representative

_____
Printed Name and Title

_____
Date

8719 Brooks Drive, Easton, Maryland 21601 Tel: 410/822-8688 Fax: 410/822-6306

REQUEST FOR INTERPRETATION FORM – CSI FORM 13.2A

Request for Interpretation Form attached shall be utilized on this project.

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Advancement of Construction Technology

REQUEST FOR INTERPRETATION

Project: _____ R.F.I. Number: _____

_____ From: _____

To: _____ Date: _____

_____ A/E Project Number: _____

Re: _____ Contract For: _____

Specification Section: Paragraph: Drawing Reference: Detail:

Request:

Signed by: Date:

Response:

☐ Attachments

Response From: To: Date Rec'd: Date Returned:

Signed by: Date:

Copies: ☐ Owner ☐ Consultants ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ File

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REQUEST FOR INTERPRETATION LOG – CSI LOG FORM 13.2B

Request for Interpretation Log attached shall be utilized on this project.

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Advancement of Construction Technology

REQUEST FOR INTERPRETATION LOG

Project: _____ A/E Project Number: _____

Owner: _____ Contractor: _____

R.F.I. NO.	DATE RECEIVED	BRIEF DESCRIPTION OF INFORMATION REQUESTED	DATE OF RESPONSE	R.F.P. NO.

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SUBSTITUTION REQUEST FORM (DURING CONSTRUCTION) – CSI FORM 13.1A

Substitution Request Form CSI Form 13.1A attached shall be utilized on this project.

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Advancement of Construction Technology

SUBSTITUTION REQUEST

(After the Bidding Phase)

Project: _____ Substitution Request Number: _____

_____ From: _____

To: _____ Date: _____

_____ A/E Project Number: _____

Re: _____ Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 2-5 years old ☐ 5-10 yrs old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

_____

_____

☐ Point-by-point comparative data attached - REQUIRED BY A/E

Reason for not providing specified item: _____

_____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

_____

Savings to Owner for accepting substitution: _____ ($ _____).

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

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SUBSTITUTION REQUEST
(Continued)

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: _____

_____

_____

_____

A/E's REVIEW AND ACTION

☐ Substitution approved - Make submittals in accordance with Specification Section 01330.
☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01330.
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: Date:

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E ☐ _____

_____

_____

_____

_____

_____

_____

_____

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ARCHITECT'S SUPPLEMENTAL INSTRUCTIONS FORM – AIA DOCUMENT G710-2017

AIA Document G710-2017 Supplemental Instructions attached shall be utilized on this project.

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AIA® Document G710™ – 2017

Architect's Supplemental Instructions

PROJECT: *(name and address)*	CONTRACT INFORMATION: Contract For: General Construction Date:	ASI INFORMATION: ASI Number: 001 Date:
OWNER: *(name and address)*	ARCHITECT: *(name and address)*	CONTRACTOR: *(name and address)*

The Contractor shall carry out the Work in accordance with the following supplemental instructions without change in Contract Sum or Contract Time. Proceeding with the Work in accordance with these instructions indicates your acknowledgment that there will be no change in the Contract Sum or Contract Time.
(Insert a detailed description of the Architect's supplemental instructions and, if applicable, attach or reference specific exhibits.)

ISSUED BY THE ARCHITECT:

ARCHITECT *(Firm name)*

SIGNATURE

PRINTED NAME AND TITLE

DATE

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CONSTRUCTION CHANGE DIRECTIVE FORM – AIA DOCUMENT G714-2017

AIA Document G714-2017 Construction Change Directive attached shall be utilized on this project.

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AIA® Document G714™ – 2017

Construction Change Directive

PROJECT: *(name and address)*	CONTRACT INFORMATION:	CCD INFORMATION:
	Contract For: General Construction Date:	Directive Number: 001 Date:
OWNER: *(name and address)*	**ARCHITECT:** *(name and address)*	**CONTRACTOR:** *(name and address)*

The Contractor is hereby directed to make the following change(s) in this Contract:
(Insert a detailed description of the change and, if applicable, attach or reference specific exhibits.)

PROPOSED ADJUSTMENTS

1. The proposed basis of adjustment to the Contract Sum or Guaranteed Maximum Price is:
   - ☒ Lump Sum decrease of $0.00
   - ☐ Unit Price of $ per
   - ☐ Cost, as defined below, plus the following fee:
     (Insert a definition of, or method for determining, cost)
   - ☐ As follows:

2. The Contract Time is proposed to remain unchanged. The proposed adjustment, if any, is (0 days).

NOTE: The Owner, Architect and Contractor should execute a Change Order to supersede this Construction Change Directive to the extent they agree upon adjustments to the Contract Sum, Contract Time, or Guaranteed Maximum price for the change(s) described herein.

When signed by the Owner and Architect and received by the Contractor, this document becomes effective IMMEDIATELY as a Construction Change Directive (CCD), and the Contractor shall proceed with the change(s) described above.

Contractor signature indicates agreement with the proposed adjustments in Contract Sum and Contract Time set forth in this CCD.

ARCHITECT *(Firm name)*	OWNER *(Firm name)*	CONTRACTOR *(Firm name)*
SIGNATURE	SIGNATURE	SIGNATURE
PRINTED NAME AND TITLE	PRINTED NAME AND TITLE	PRINTED NAME AND TITLE
DATE	DATE	DATE

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PROPOSAL REQUEST FORM – AIA DOCUMENT G709-2018

AIA Document G709 Proposal Request attached shall be utilized on this project.

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AIA® Document G709™ – 2018

Proposal Request

PROJECT: *(name and address)* TEST	**CONTRACT INFORMATION:** Contract For: General Construction Date:	Architect's Project Number: Proposal Request Number: 001 Proposal Request Date:
OWNER: *(name and address)*	**ARCHITECT:** *(name and address)*	**CONTRACTOR:** *(name and address)*

The Owner requests an itemized proposal for changes to the Contract Sum and Contract Time for proposed modifications to the Contract Documents described herein. The Contractor shall submit this proposal within Zero (0) days or notify the Architect in writing of the anticipated date of submission.
(Insert a detailed description of the proposed modifications to the Contract Documents and, if applicable, attach or reference specific exhibits.)

THIS IS NOT A CHANGE ORDER, A CONSTRUCTION CHANGE DIRECTIVE, OR A DIRECTION TO PROCEED WITH THE WORK DESCRIBED IN THE PROPOSED MODIFICATIONS.

REQUESTED BY THE ARCHITECT:

PRINTED NAME AND TITLE

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CHANGE ORDER FORM – AIA DOCUMENT G701-2017

AIA Document G701 - Change Order attached shall be utilized on this project.

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AIA® Document G701™ – 2017

Change Order

PROJECT: *(Name and address)*	CONTRACT INFORMATION:	CHANGE ORDER INFORMATION:
	Contract For: General Construction Date:	Change Order Number: 001 Date:
OWNER: *(Name and address)*	**ARCHITECT:** *(Name and address)*	**CONTRACTOR:** *(Name and address)*

THE CONTRACT IS CHANGED AS FOLLOWS:
(Insert a detailed description of the change and, if applicable, attach or reference specific exhibits. Also include agreed upon adjustments attributable to executed Construction Change Directives.)

The original Contract Sum was	$	0.00
The net change by previously authorized Change Orders	$	0.00
The Contract Sum prior to this Change Order was	$	0.00
The Contract Sum will be increased by this Change Order in the amount of	$	0.00
The new Contract Sum including this Change Order will be	$	0.00

The Contract Time will be increased by Zero (0) days.
The new date of Substantial Completion will be

NOTE: This Change Order does not include adjustments to the Contract Sum or Guaranteed Maximum Price, or the Contract Time, that have been authorized by Construction Change Directive until the cost and time have been agreed upon by both the Owner and Contractor, in which case a Change Order is executed to supersede the Construction Change Directive.

NOT VALID UNTIL SIGNED BY THE ARCHITECT, CONTRACTOR AND OWNER.

ARCHITECT *(Firm name)*	CONTRACTOR *(Firm name)*	OWNER *(Firm name)*
SIGNATURE	SIGNATURE	SIGNATURE
PRINTED NAME AND TITLE	PRINTED NAME AND TITLE	PRINTED NAME AND TITLE
DATE	DATE	DATE

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ALLOWANCE AUTHORIZATION FORM

Allowance Authorization Form attached shall be utilized on this project.

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ALLOWANCE AUTHORIZATION

Project:

Architect: Project No.:

Contractor:

AAA No.: Initiation Date:

The Allowance is allocated as follows:

Total original Contract Allowance was:	$
Amount of Contract Allowance Access previously authorized:	$
Adjusted Contract Allowance prior to this authorization is:	$
The amount of available allowance will decrease by this Access Authorization:	$
The remaining Contract Allowance, after this Access Authorization will be:	$

Recommended by:
Architect

By (Signature):_____

Date:_____

Accepted by:
Contractor

Approved by:
Owner

By (Signature):_____ By (Signature):_____

Date:_____ Date:_____

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CERTIFICATE OF SUBSTANTIAL COMPLETION FORM – AIA DOCUMENT G704-2017

AIA Document G704-2017 Certificate of Substantial Completion Form attached shall be utilized on this project.

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AIA® Document G704™ – 2017

Certificate of Substantial Completion

PROJECT: *(name and address)*	CONTRACT INFORMATION: Contract For: General Construction Date:	CERTIFICATE INFORMATION: Certificate Number: 001 Date:
OWNER: *(name and address)*	ARCHITECT: *(name and address)*	CONTRACTOR: *(name and address)*

The Work identified below has been reviewed and found, to the Architect's best knowledge, information, and belief, to be substantially complete. Substantial Completion is the stage in the progress of the Work when the Work or designated portion is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use. The date of Substantial Completion of the Project or portion designated below is the date established by this Certificate.
(Identify the Work, or portion thereof, that is substantially complete.)

ARCHITECT *(Firm Name)*	SIGNATURE	PRINTED NAME AND TITLE	DATE OF SUBSTANTIAL COMPLETION

WARRANTIES
The date of Substantial Completion of the Project or portion designated above is also the date of commencement of applicable warranties required by the Contract Documents, except as stated below:
(Identify warranties that do not commence on the date of Substantial Completion, if any, and indicate their date of commencement.)

WORK TO BE COMPLETED OR CORRECTED
A list of items to be completed or corrected is attached hereto, or transmitted as agreed upon by the parties, and identified as follows:
(Identify the list of Work to be completed or corrected.)

The failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. Unless otherwise agreed to in writing, the date of commencement of warranties for items on the attached list will be the date of issuance of the final Certificate of Payment or the date of final payment, whichever occurs first. The Contractor will complete or correct the Work on the list of items attached hereto within ( ) days from the above date of Substantial Completion.

Cost estimate of Work to be completed or corrected: $

The responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work, insurance, and other items identified below shall be as follows:
(Note: Owner's and Contractor's legal and insurance counsel should review insurance requirements and coverage.)

The Owner and Contractor hereby accept the responsibilities assigned to them in this Certificate of Substantial Completion:

CONTRACTOR *(Firm Name)*	SIGNATURE	PRINTED NAME AND TITLE	DATE
OWNER *(Firm Name)*	SIGNATURE	PRINTED NAME AND TITLE	DATE

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AFFIDAVIT OF PAYMENT OF DEBTS AND CLAIMS FORM – AIA DOCUMENT G706-1994

AIA Document G706 Affidavit of Payment of Debts and Claims Form attached shall be utilized on this project.

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AIA® Document G706™ – 1994

Contractor's Affidavit of Payment of Debts and Claims

PROJECT: *(Name and address)*	**ARCHITECT'S PROJECT NUMBER:**	OWNER: ☐
		ARCHITECT: ☐
	CONTRACT FOR: General Construction	CONTRACTOR: ☐
TO OWNER: *(Name and address)*	**CONTRACT DATED:**	SURETY: ☐
		OTHER: ☐

STATE OF:
COUNTY OF:

The undersigned hereby certifies that, except as listed below, payment has been made in full and all obligations have otherwise been satisfied for all materials and equipment furnished, for all work, labor, and services performed, and for all known indebtedness and claims against the Contractor for damages arising in any manner in connection with the performance of the Contract referenced above for which the Owner or Owner's property might in any way be held responsible or encumbered.

EXCEPTIONS:

SUPPORTING DOCUMENTS ATTACHED HERETO:

1. Consent of Surety to Final Payment. Whenever Surety is involved, Consent of Surety is required. AIA Document G707, Consent of Surety, may be used for this purpose

Indicate Attachment ☐ Yes ☒ No

The following supporting documents should be attached hereto if required by the Owner:

1. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.
2. Separate Releases or Waivers of Liens from Subcontractors and material and equipment suppliers, to the extent required by the Owner, accompanied by a list thereof.
3. Contractor's Affidavit of Release of Liens (AIA Document G706A).

CONTRACTOR: *(Name and address)*

BY: _____
(Signature of authorized representative)

_____
(Printed name and title)

Subscribed and sworn to before me on this date:

Notary Public:
My Commission Expires:

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AFFIDAVIT OF RELEASE OF LIENS FORM – AIA DOCUMENT G706A-1994

AIA Document G706A-1994 - Affidavit of Release of Liens Form attached shall be utilized on this project.

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AIA® Document G706A™ – 1994

Contractor's Affidavit of Release of Liens

PROJECT: *(Name and address)* TEST	**ARCHITECT'S PROJECT NUMBER:**	OWNER: ☐
	CONTRACT FOR: General Construction	ARCHITECT: ☐
TO OWNER: *(Name and address)*	**CONTRACT DATED:**	CONTRACTOR: ☐
		SURETY: ☐
		OTHER: ☐

STATE OF:
COUNTY OF:

The undersigned hereby certifies that to the best of the undersigned's knowledge, information and belief, except as listed below, the Releases or Waivers of Lien attached hereto include the Contractor, all Subcontractors, all suppliers of materials and equipment, and all performers of Work, labor or services who have or may have liens or encumbrances or the right to assert liens or encumbrances against any property of the Owner arising in any manner out of the performance of the Contract referenced above.

EXCEPTIONS:

SUPPORTING DOCUMENTS ATTACHED HERETO:

1. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.

2. Separate Releases or Waivers of Liens from Subcontractors and material and equipment suppliers, to the extent required by the Owner, accompanied by a list thereof.

CONTRACTOR: *(Name and address)*

BY: _____
(Signature of authorized representative)

_____
(Printed name and title)

Subscribed and sworn to before me on this date:

Notary Public:
My Commission Expires:

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CONSENT OF SURETY TO FINAL PAYMENT FORM – AIA DOCUMENT G707-1994

AIA Document G707-1994 - Consent of Surety to Final Payment Form attached shall be utilized on this project.

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AIA® Document G707™ – 1994

Consent Of Surety to Final Payment

PROJECT: *(Name and address)* TEST	**ARCHITECT'S PROJECT NUMBER:**	OWNER: ☐
	CONTRACT FOR: General Construction	ARCHITECT: ☐
		CONTRACTOR: ☐
TO OWNER: *(Name and address)*	**CONTRACT DATED:**	SURETY: ☐
		OTHER: ☐

In accordance with the provisions of the Contract between the Owner and the Contractor as indicated above, the
(Insert name and address of Surety)

, SURETY,

on bond of
(Insert name and address of Contractor)

, CONTRACTOR,

hereby approves of the final payment to the Contractor, and agrees that final payment to the Contractor shall not relieve the Surety of any of its obligations to
(Insert name and address of Owner)

, OWNER,

as set forth in said Surety's bond.

IN WITNESS WHEREOF, the Surety has hereunto set its hand on this date:
(Insert in writing the month followed by the numeric date and year.)

_____
(Surety)

_____
(Signature of authorized representative)

Attest:
(Seal):

_____
(Printed name and title)

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GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION – AIA DOCUMENT A201-2017

The General Conditions of this Contract are as stated in the American Institute of Architects Document AIA A201 (2017 Edition) entitled General Conditions of the Contract for Construction and is part of this project manual as if herein written in full.

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AIA® Document A201™ – 2017

General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)

THE OWNER:
(Name, legal status and address)

THE ARCHITECT:
(Name, legal status and address)

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13 MISCELLANEOUS PROVISIONS

14 TERMINATION OR SUSPENSION OF THE CONTRACT

15 CLAIMS AND DISPUTES

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. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

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

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.

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1.1.1, 2.4, 3.9, 7, 8.2.2, 12.1, 12.2, 13.4.2, 14.3.1

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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 or proposal 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. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

§ 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

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consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 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 retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and 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 the 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 suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, 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 suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

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§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

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 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 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,

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assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.3.2 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.

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

§ 2.3.4 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.

§ 2.3.5 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.

§ 2.3.6 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.

§ 2.4 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.

§ 2.5 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 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 default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for 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. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

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 its 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 2.3.4, 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 submit 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, subject to Section 15.1.7, 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. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be 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 notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative 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 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.

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§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 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

§ 3.5.1 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.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 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 14 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 that an equitable adjustment be made 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, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

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§ 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 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 notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice 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 and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably 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, or fails to provide submittals in accordance with the approved submittal schedule, the

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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.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and 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 how 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 the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect 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.

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§ 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 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 required to provide professional services in violation of applicable law.

§ 3.12.10.1 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 be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately 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 and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and 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.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

§ 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, 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, or patching shall be restored to the condition existing prior to the cutting, fitting, or 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 construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its 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 and 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 the Owner shall be entitled to reimbursement from the Contractor.

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§ 3.16 Access to Work
The Contractor shall provide the Owner and Architect with 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 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 an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

§ 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 Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 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.

§ 4.2 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.

§ 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 promptly report to the Owner (1) known deviations from the

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Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) 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.

§ 4.2.4 Communications

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 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 13.4.2 and 13.4.3, whether or not the 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, 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 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 order 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 Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 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

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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.

§ 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 the 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, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice 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 for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations

By appropriate written agreement, 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 that the Contractor, by these Contract 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,

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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 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; 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 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 term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 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 any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its 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 or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has 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,

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promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 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 that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor 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. The Contractor shall proceed promptly with changes in the Work, 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:

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.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
.4 As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine 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 7.3.4 shall be limited to the following:

.1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
.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, directly related to the change; and
.5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 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.

§ 7.3.7 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.

§ 7.3.8 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 may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will

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affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

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, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 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 (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended 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

§ 9.1.1 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.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

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

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unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent 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. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 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 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, suppliers, or other persons or entities that 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 (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole 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 in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. 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. 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 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.

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§ 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;
- .3 failure of the Contractor to make payments properly to Subcontractors or suppliers 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 either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

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

§ 9.5.4 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 supplier 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 Contractor shall reflect such payment on its next Application 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 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 and suppliers 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 or supplier, except as may otherwise be required by law.

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

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§ 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 or provided by 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, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 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' notice to the Owner and Architect, 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 shutdown, 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; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and 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 the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the 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.

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§ 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 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 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. When the 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 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, (3) a written statement that the Contractor knows of no 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, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and 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, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance 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 the lien, claim, security interest, or encumbrance, 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, corrected, 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 the 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.

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§ 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;
.3 terms of special warranties required by the Contract Documents; or
.4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a 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, a Subcontractor, or a Sub-subcontractor; 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.

§ 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 implement, 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 the owners and users of adjacent sites and utilities of the safeguards.

§ 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. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is 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.

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§ 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, notice of the 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 and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. 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 notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's 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 the material or substance or who are to perform the task of removal or safe containment of the 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 by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 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 hazardous 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 hazardous 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 reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances 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 reimburse 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.

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ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 11.1.3 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.

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

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§ 11.3 Waivers of Subrogation

§ 11.3.1 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; (2) the Architect and Architect's consultants; and (3) Separate Contractors, 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 those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 11.3.2 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, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

§11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement 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 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

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, the Contractor shall be entitled to an equitable adjustment to

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the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before 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 any 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 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 2.5.

§ 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 of the Owner or Separate Contractors, whether completed or partially completed, 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, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

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§ 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 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 the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 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.

§ 13.3.2 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 thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 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 tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 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 13.4.1, 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 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 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.

§ 13.4.4 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.

§ 13.4.5 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.

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

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties 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.

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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, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, 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;

.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 reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, 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' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work 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' 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 or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;

.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 reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner 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' 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,

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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.

§ 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 under 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 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 Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

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, a change in the Contract Time, 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. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the 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 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by 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 under this Section 15.1.3.1 shall 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.

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§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 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.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 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.

§ 15.1.6.2 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.

§ 15.1.7 Waiver of 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 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, 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. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a 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

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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 the 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 receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 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 15.1.7, 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 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

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§ 15.3.4 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. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. 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 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party 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 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party 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 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 those of the Owner and Contractor under this Agreement.

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_____

(Signed)

_____

(Title)

_____

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SUPPLEMENTARY GENERAL CONDITIONS – AIA DOCUMENT A201-2017

The following supplements modify the "General Conditions of the Contract for Construction," AIA Document A201-2017. Where a portion of the General Conditions is modified or deleted by the Supplementary Conditions, the unaltered portions of the General Conditions shall remain in effect.

TABLE OF ARTICLES

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5. SUBCONTRACTORS

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ARTICLE 1: GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

1.1.1 THE CONTRACT DOCUMENTS

Delete the last sentence in its entirety and replace with the following:

"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."

Add the following Paragraph:

1.1.1.1 In the event of conflict or discrepancies among the Contract Documents, the Documents prepared by the State of Delaware, Division of Facilities Management shall take precedence over all other documents.

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

Add the following Paragraphs:

1.2.4 In the case of an inconsistency between the Drawings and the Specifications, or within either document not clarified by addendum, the better quality or greater quantity of work shall be provided in accordance with the Architect's interpretation.

1.2.5 The word "PROVIDE" as used in the Contract Documents shall mean "FURNISH AND INSTALL" and shall include, without limitation, all labor, materials, equipment, transportation, services and other items required to complete the Work.

1.2.6 The word "PRODUCT" as used in the Contract Documents means all materials, systems and equipment.

1.2.7 "Sections of Division 01 "General Requirements" govern by execution of the work of all sections of the specifications.

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

Delete Paragraph 1.5.1 in its entirety and replace with the following:

"All pre-design studies, drawings, specifications and other documents, including those in electronic form, prepared by the Architect under this Agreement are, and shall remain, the property of the Owner whether the Project for which they are made is executed or not. Such documents may be used by the Owner to construct one or more like Projects without the approval of, or additional compensation to, the Architect. The Contractor, Subcontractors, Sub-subcontractors and Material or Equipment Suppliers are authorized to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the Architect and the Architect's consultants appropriate to and for use in the execution of their Work under the Contract Documents. They are not to be used by the

Contractor or any Subcontractor, Sub-subcontractor or Material and Equipment Supplier 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 Architect's consultants.

The Architect shall not be liable for injury or damage resulting from the re-use of drawings and specifications if the Architect is not involved in the re-use Project. Prior to re-use of construction documents for a Project in which the Architect is not also involved, the Owner will remove from such documents all identification of the original Architect, including name, address and professional seal or stamp."

Delete Paragraph 1.5.2 in its entirety.

ARTICLE 2: OWNER

2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

To Subparagraph 2.2.3 – 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 cost for any repairs required, out of failure to accurately identify said utilities."

Delete Subparagraph 2.2.5 in its entirety and substitute the following:

2.2.5 The Contractor shall be furnished free of charge up to three (3) sets of the Drawings and Project Manuals. Additional sets will be furnished at the cost of reproduction, postage and handling.

ARTICLE 3: CONTRACTOR

3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

Amend Paragraph 3.2.2 to state that any errors, inconsistencies or omissions discovered shall be reported to the Architect and Owner immediately.

Delete the third sentence in Paragraph 3.2.3.

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

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 the Architect.

3.3.4 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.

3.3.5 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 LABOR AND MATERIALS

Add the Following Paragraphs:

3.4.4 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 will not be recognized.

3.4.5 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 that Work, who shall maintain coordination at all times.

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 **two years** 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 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 two years as above, and are particularly so stated in that 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.

3.5.5 The warranty provided in paragraph 3.5 shall be concurrent with and not limited of any other warranty required by the Contract Documents. The Contractor shall repair or replace those products found not to be in compliance with the

warranty terms during the period of two (2) years after the date of substantial completion.

3.5.6 The Contractor shall secure and pay for all other permits including but not limited to HVAC and electrical permits. Costs of all permits shall be included in the Base Bid.

3.5.7 The Superintendent shall be satisfactory to the Engineer and Owner and upon request shall furnish them within seven (7) days his/her qualifications to supervise the project. The Superintendent shall not be changed except with the consent of the Owner, unless he proves to be unsatisfactory to the contractor and ceases to be in his employment.

3.11 DOCUMENTS AND SAMPLES AT THE SITE

Add the following Paragraphs:

3.11.1 During the course of the Work, the Contractor shall maintain a record set of drawings on which the Contractor shall mark the actual physical location of all piping, valves, equipment, conduit, outlets, access panels, controls, actuators, including all appurtenances that will be concealed once construction is complete, etc., including all invert elevations.

3.11.2 At the completion of the project, the Contractor shall obtain a set of reproducible drawings from the Architect, and neatly transfer all information outlined in 3.11.1 to provide a complete record of the as-built conditions.

3.11.3 The Contractor shall provide two (2) prints of the as-built conditions, along with the reproducible drawings themselves, to the Owner and one (1) set to the Architect. In addition, attach one complete set to each of the Operating and Maintenance Instructions/Manuals.

3.11.4 The Contractor shall, on a daily basis, police and clean the site and surrounding areas of the project of this materials, rubbish, tools, construction equipment, machinery or any materials to be stored thereon, either temporarily or permanently.

3.17 In the second sentence of the paragraph, insert “indemnify” between “shall” and “hold”.

ARTICLE 4: ADMINISTRATION OF THE CONTRACT

4.2 ADMINISTRATION OF THE CONTRACT

Delete the first sentence of Paragraph 4.2.7 and replace with the following:

The Architect will review and approve or take other appropriate action upon the Contractor’s submittals such as Shop Drawings, Product Data and Samples for the purpose of checking for conformance with the Contract Documents.

Delete the second sentence of Paragraph 4.2.7 and replace with the following:

The Architect's action will be taken with such reasonable promptness as to cause no delay in the Work in the activities of the Owner, Contractor or separate Contractors, while allowing sufficient time in the Owner's professional judgment to permit adequate review.

Add the following Paragraph:

4.2.10.1 There will be no full-time project representative provided by the Owner or Architect on this project.

Add to Paragraph 4.2.13 "and in compliance with all local requirements." to the end of the sentence

ARTICLE 5: SUBCONTRACTORS

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

Delete Paragraph 5.2.3 in its entirety and replace with the following:

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, subject to the statutory requirements of 29 Delaware Code § 6962(d)(10)b.3 and 4.

ARTICLE 6: CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

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

Delete Paragraph 6.1.4 in its entirety.

6.2 MUTUAL RESPONSIBILITY

6.2.3 In the second sentence, strike the word "shall" and insert the word "may".

ARTICLE 7: CHANGES IN THE WORK

(SEE ARTICLE 7: CHANGES IN WORK IN THE GENERAL REQUIREMENTS)

ARTICLE 8: TIME

8.2 PROGRESS AND COMPLETION

Add the following Paragraphs:

8.2.1.1 Refer to Specification Section SUMMARY OF WORK for Contract time requirements.

8.2.4 If the Work falls behind the 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.

8.3 DELAYS AND EXTENSION OF TIME

8.3.1 Strike “arbitration” and insert “remedies at law or in equity”.

Add the following Paragraph:

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 their rights under the Contract.

ARTICLE 9: PAYMENTS AND COMPLETION

9.2 SCHEDULE OF VALUES

Add the following Paragraphs:

9.2.1 The Schedule of Values shall be submitted using AIA Document G702, Continuation Sheet to G703.

9.2.2 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 1% of the initial contract amount.

9.3 APPLICATIONS FOR PAYMENT

Add the following Paragraph:

9.3.1.3 Application for Payment shall be submitted on AIA Document G702 “Application and Certificate for Payment”, supported by AIA Document G703 “Continuation Sheet”. Said Applications shall be fully executed and notarized.

Add the following Paragraphs:

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.

9.3.5 The Contractor shall provide a current and updated Progress Schedule to the Architect with each Application for Payment. Failure to provide Schedule will be just cause for rejection of Application for Payment.

9.5 DECISIONS TO WITHHOLD CERTIFICATION

Add the following to 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.

9.6 PROGRESS PAYMENTS

Delete Paragraph 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 for Payment.

9.7 FAILURE OF PAYMENT

In first sentence, strike "seven" and insert "thirty (30)". Also strike "binding dispute resolution" and insert "remedies at law or in equity".

9.8 SUBSTANTIAL COMPLETION

To Subparagraph 9.8.3 - Add the following sentence:

"If the Architect is required to make more than 2 inspections of the same portion of work, the Contractor shall be responsible for all costs associated with subsequent inspections including but not limited to any Architect's fees."

9.8.5 In the second sentence, strike "shall" and insert "may".

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY PRECAUTIONS AND PROGRAMS

Add the following Paragraphs:

10.1.1.1.1 Each 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 Each Contractor shall appoint a Safety Representative. Safety Representatives shall be someone who is on site on a full time basis. 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 meetings by the Contractor and will be distributed to all parties as well as posted in all job offices/trailers etc.

10.2 SAFETY OF PERSONS AND PROPERTY

Add the following Paragraph:

10.2.4.1 As required in the Hazardous Chemical Act of June 1984, all vendors supplying any material that may be defined as hazardous must provide Material Safety Data Sheets for those products. Any chemical product should be considered hazardous if it has a caution warning on the label relating to a potential physical or health hazard, if it is known to be present in the work place, and if employees may be exposed under normal conditions or in foreseeable emergency situations. Material Safety Data Sheets shall be provided directly to the Owner, along with the shipping slips that include those products.

10.3 HAZARDOUS MATERIALS

Delete Paragraph 10.3.3 in its entirety.

Delete Paragraph 10.3.6 in its entirety.

ARTICLE 11: INSURANCE AND BONDS

11.1 CONTRACTOR'S LIABILITY INSURANCE

11.1.4 Strike "the Owner" immediately following "(1)" and strike "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

Delete Paragraph 11.2 in its entirety.

11.3 PROPERTY INSURANCE

Delete Paragraph 11.3 in its entirety and replace with the following:

11.3 The State will not provide Builder's All Risk Insurance for the Project. The Contractor and all Subcontractors shall provide property coverage for their tools and equipment, as necessary. Any mandatory deductible required by the Contractor's Insurance shall be the responsibility of the Contractor.

11.4 PERFORMANCE BOND AND PAYMENT BOND

11.4.1 Add the following sentence: "The bonds will conform to those forms approved by the Office of Management and Budget."

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

12.2.2 AFTER SUBSTANTIAL COMPLETION

Add the following Paragraph:

12.2.2.1.1 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 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.

12.2.2.1 Strike "one" and insert "two".

12.2.2.2 Strike "one" and insert "two".

12.2.2.3 Strike "one" and insert "two".

12.2.5 In second sentence, strike "one" and insert "two".

ARTICLE 13: MISCELLANEOUS PROVISIONS

13.1 GOVERNING LAW

Strike "except that, if the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4."

13.6 INTEREST

Strike "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." Insert "30 days of presentment of the authorized Certificate of Payment at the annual rate of 12% or 1% per month.

13.7 TIME LIMITS ON CLAIMS

Strike the last sentence.

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 State of America, the Contractor shall notify the Architect and Owner immediately upon discovery.

ARTICLE 14: TERMINATION OR SUSPENSION OF THE CONTRACT

14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

Delete Paragraph 14.4.3 in its entirety and replace with the following:

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 cost incurred by reason of such termination along with reasonable overhead.

ARTICLE 15: CLAIMS AND DISPUTES

15.1.2 Throughout the Paragraph strike "21" and insert "45".

15.1.6 CLAIMS FOR CONSEQUENTIAL DAMAGES

Delete Paragraph 15.1.6 in its entirety.

15.2 INITIAL DECISION

Delete Paragraph 15.2.5 in its entirety and replace with the following:

15.2.5 The Architect will approve or reject Claims by written decision, which shall state the reasons therefore and shall notify the parties of any change in the Contract Sum or Contract Time or both. The approval or rejection of a Claim by the Architect shall be subject to mediation and other remedies at law or in equity.

Delete Paragraph 15.2.6 and its subparagraphs in their entirety.

15.3 MEDIATION

15.3.1 Strike "binding dispute resolution" and insert "any or all remedies at law or in equity".

15.3.2 In the first sentence, delete "administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedure in effect on the date of the Agreement," Strike "binding dispute resolution" and insert "remedies at law and in equity".

15.4 ARBITRATION

Delete Paragraph 15.4 and its sub-sections in its entirety.

ARTICLE 16 - LIQUIDATED DAMAGES

16.1 "It is expressly understood and agreed by and between the Contractor and the Owner that the Contract time stipulated in the bid form is a reasonable time for completion of the work, taking into consideration the average climatic range and the usual conditions prevailing in the locality of the project. Time is an essential element of the contract and it is important that the work be vigorously prosecuted and conform to the scheduled start and finish dates of the Construction Documents."

16.2 "The Contractor agrees that he can and will substantially complete the total projects work in accordance with the Contract Documents within the stated Contract Time."

16.3 "The Owner and Contractor agree that due to the uniqueness of this contract and the fact that the Owner is a private agency and the relevant factors, damages resulting from failure of the Contractor to perform the contract within the time specified therefore will result in damages to the Owner which shall be difficult, if not impossible, to ascertain; therefore, the provision for damages herein specified shall be applied in the event of such a default. The Owner and the Contractor, both of whom are, by their own admissions, sophisticated business entities with prior experience in dealing with construction contracts, stipulate that damages shall be the sum of $300.00 for each day that the work shall remain uncompleted beyond the time(s) specified elsewhere in the contract, provided, however, that due account shall be taken of any adjustment of specified completion time(s) for completion of work as granted by approved change orders."

16.4 "The Contractor, by the execution of the contract document, does hereby irrevocably constitute, designate and appoint the Owner to be his agent for the limited but express purpose of deducting on a daily basis the liquidated damages as above determined from the balance of the contract funds in the hands of the Owner and due to the Contractor, and the failure of the Owner to deduct such sum for any day or any combination of days, whether consecutive or not, shall not operates as a waiver of such liquidated damages for that period, and such damages for such day or days shall be cumulative and may be subsequently deducted by the Owner from such sums as may be due the Contractor, but work performed. In the event that the amounts due the Contractor are less than the amount of such damages, the Contractor, shall be liable to the Owner for the difference."

16.5 "The power granted by the Contractor to the Owner above is a power coupled with an interest and is irrevocable."

END OF SUPPLEMENTARY GENERAL CONDITIONS

WAGE RATE REQUIREMENTS

The State of Delaware Wage Rate Requirements that shall be utilized on this project. The State of Delaware issues specific wage rates for Sate of Delaware funded projects.

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STATE OF DELAWARE
DEPARTMENT OF LABOR
DIVISION OF INDUSTRIAL AFFAIRS
4425 NORTH MARKET STREET
WILMINGTON, DELAWARE 19802

TELEPHONE (302) 761-8200
FAX (302) 761-6601

Via Electronic and Regular Mail

March 20, 2019

Mr. R. Adam Kegan
Gipe Associates, Inc.
8719 Brooks Drive
Easton, MD 21601

Re: 1907 Delcastle High School Chiller Cooling tower refurbishment, New Castle County, DE

Dear Mr. Kegan:

I am responding to your request for a category determination for the 1907 Delcastle High School Chiller Cooling tower refurbishment, which is a state funded construction project located in New Castle County, DE. The work consists of replacement of chiller starter and refurbishment of existing water cooled chiller. Refurbish cooling tower and fan. Provide new tower fan vfd. provide new condenser water pump. You estimate the total cost of construction for this project to be $300,000.00.

Based upon the information you provided the Department of Labor has determined that this project is a Building Construction project.

Delaware's Prevailing Wage Regulations provide that the rates applicable to a project are the rates in effect on the date of publication of the specifications for that project. I have enclosed a certified copy of the March 15, 2019, prevailing wage rates for Building Construction to be included in your bid specification. However, please be advised that, in the event that a contract for a project is not executed within one hundred and twenty (120) days from the earliest date the specifications were published, the rates in effect at the time of the execution of the contract shall be the applicable rates for the project.

This determination is directed solely to the parties identified herein. It is based on the unique facts relevant to this matter. It does not constitute precedent and should not be cited as such by future parties.

Lastly, please see the enclosed debarment list. Entities/individuals listed shall not be permitted to bid on, be awarded or work on Delaware State funded construction projects, in the timeframe specified, as provided for under 29 Del.C. §6960 or other applicable State statutes.

If you have any questions or I can provide any additional assistance, please do not hesitate to contact me at 302-761-8325.

Sincerely,

Curtis Washington
Labor Law Enforcement Officer
curtisl.washington@delaware.gov

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WAGE RATE DETERMINATION SCHEDULE

Enclosed is a copy of the State of Delaware Wage Rate Determination Schedule that shall be utilized on this project.

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STATE OF DELAWARE
DEPARTMENT OF LABOR
DIVISION OF INDUSTRIAL AFFAIRS
OFFICE OF LABOR LAW ENFORCEMENT
PHONE: (302) 761-8200

Mailing Address:
4425 North Market Street
3rd Floor
Wilmington, DE 19802

Located at:
4425 North Market Street
3rd Floor
Wilmington, DE 19802

PREVAILING WAGES FOR **BUILDING CONSTRUCTION** EFFECTIVE MARCH 15, 2019

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
ASBESTOS WORKERS	23.92	29.46	42.87
BOILERMAKERS	71.61	36.33	53.41
BRICKLAYERS	55.89	55.89	55.89
CARPENTERS	55.63	55.63	44.22
CEMENT FINISHERS	75.54	52.62	23.19
ELECTRICAL LINE WORKERS	47.57	40.79	31.10
ELECTRICIANS	70.49	70.49	70.49
ELEVATOR CONSTRUCTORS	96.27	67.47	33.42
GLAZIERS	75.65	75.65	59.28
INSULATORS	57.88	57.88	57.88
IRON WORKERS	65.57	65.57	65.57
LABORERS	47.70	47.70	47.70
MILLWRIGHTS	74.23	74.23	59.84
PAINTERS	52.47	52.47	52.47
PILEDRIVERS	78.02	41.17	33.30
PLASTERERS	31.22	31.22	23.14
PLUMBERS/PIPEFITTERS/STEAMFITTERS	70.05	55.29	60.31
POWER EQUIPMENT OPERATORS	71.29	71.29	71.29
ROOFERS-COMPOSITION	25.12	24.79	22.64
ROOFERS-SHINGLE/SLATE/TILE	19.24	22.88	17.99
SHEET METAL WORKERS	72.53	72.53	72.53
SOFT FLOOR LAYERS	53.39	53.39	53.39
SPRINKLER FITTERS	60.04	60.04	60.04
TERRAZZO/MARBLE/TILE FNRS	64.45	64.45	64.45
TERRAZZO/MARBLE/TILE STRS	71.27	71.27	71.27
TRUCK DRIVERS	32.19	28.70	21.91

CERTIFIED: 03/20/2019 BY: [signature] on behalf of Mike Petrone
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 302-761-8200.

NON-REGISTERED APPRENTICES MUST BE PAID THE MECHANIC'S RATE.

PROJECT: 1907 Delcastle High School Chiller Cooling tower refurbishment, New Castle County

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PREVAILING WAGE DEBARMENT LIST

The following contractors have been debarred for violations of the prevailing wage law 29Del.C. §6960 or other applicable State statutes.

Therefore, no public construction contract in this State shall be bid on, awarded to, or received by contractors and individuals on this list for a period of (3) three years from the date of the judgment or as deemed by a court of competent jurisdiction.

Contractor	Address	Date of Debarment
Mullen Brothers, Inc. and Daniel Mullen, individually	3375 Garnett Road, Boothwyn, PA 19060	Indefinite/ Civil Contempt
State Contractors Corporation, and Jose Oscar Rivera, individually	13004 Hathaway Drive Silver Spring, MD 20906	Indefinite/ 19 Del.C. 2374(f)
Green Granite and Jason Green, individually	604 Heatherbrooke Court Avondale, PA 19311	Indefinite/ Civil Contempt
Pro Image Landscaping, Inc. and Owner(s) individually	23 Commerce Street Wilmington, DE 19801 and/or 2 Cameo Road Claymont, DE 19703	Indefinite/19 Del.C. §108 & 10 Del.C. 542(c)
Liberty Mechanical, LLC and Owner(s), individually	2032 Duncan Road Wilmington, DE 19801	Indefinite/ 19 Del.C. 2374(f)
Integrated Mechanical and Fire Systems Inc. and Allison Sheldon, individually	4601 Governor Printz Boulevard Wilmington, DE 19809	Indefinite/19 Del.C. §108 & 10 Del.C. 542(c)

Updated: January 22, 2019

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GENERAL REQUIREMENTS

TABLE OF ARTICLES

1. GENERAL PROVISIONS

2. OWNER

3. CONTRACTOR

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5. SUBCONTRACTORS

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7. CHANGES IN THE WORK

8. TIME

9. PAYMENTS AND COMPLETION

10. PROTECTION OF PERSONS AND PROPERTY

11. INSURANCE AND BONDS

12. UNCOVERING AND CORRECTION OF WORK

13. MISCELLANEOUS PROVISIONS

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ARTICLE 1: GENERAL

1.1 CONTRACT DOCUMENTS

1.1.1 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 to an extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results.

1.1.2 Work including material purchases shall not begin until the Contractor is in receipt of a bonafide State of Delaware Purchase Order. Any work performed or material purchases prior to the issuance of the Purchase Order is done at the Contractor's own risk and cost.

1.2 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

1.2.1 For Public Works Projects financed in whole or in part by state appropriation the Contractor agrees that during the performance of this contract:

1. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, sex, color, sexual orientation, gender identity 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, sex, color, sexual orientation, gender identity 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.

2. 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, sex, color, sexual orientation, gender identity or national origin."

ARTICLE 2: OWNER

(NO ADDITIONAL GENERAL REQUIREMENTS – SEE SUPPLEMENTARY GENERAL CONDITIONS)

ARTICLE 3: CONTRACTOR

3.1 Schedule of Values: The successful Bidder shall within twenty (20) days after receiving notice to proceed with the work, furnish to the Owner a complete schedule of values on the various items comprising the work.

3.2 Subcontracts: Upon approval of Subcontractors, the Contractor shall award their Subcontracts as soon as possible after the signing of their own contract and see that all

material, their own and those of their Subcontractors, are promptly ordered so that the work will not be delayed by failure of materials to arrive on time.

3.3 Before commencing any work or construction, the General Contractor is to consult with the Owner as to matters in connection with access to the site and the allocation of Ground Areas for the various features of hauling, storage, etc.

3.4 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.

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

3.6 The Contractor warrants to the Owner that materials and equipment furnished will be new and of good quality, unless otherwise permitted, and that the work will be free from defects and in conformance with the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved, may be considered defective. If required by the Owner, the Contractor shall furnish evidence as to the kind and quality of materials and equipment provided.

3.7 Unless otherwise provided, the Contractor shall pay all sales, consumer, use and other similar taxes, and shall secure and pay for required permits, fees, licenses, and inspections necessary for proper execution of the Work.

3.8 The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on performance of the Work. The Contractor shall promptly notify the Owner if the Drawings and Specifications are observed to be at variance therewith.

3.9 The Contractor shall be responsible to the Owner for the acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons performing portions of the Work under contract with the Contractor.

3.10 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 from and about the Project all waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials. The Contractor shall be responsible for returning all damaged areas to their original conditions.

3.11 STATE LICENSE AND TAX REQUIREMENTS

3.11.1 Each 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 Delaware Department of Finance within ten (10) days after entering into any contract with a contractor or subcontractor not a resident of this State, a statement of total value of such contract or contracts together with the names and addresses of the contracting parties."

3.12 The Contractor shall comply with all requirements set forth in Section 6962, Chapter 69, Title 29 of the Delaware Code.

3.13 During the contract Work, the Contractor and each Subcontractor, shall implement an Employee Drug Testing Program in accordance with OMB Regulation 4104 - "Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on "Large Public Works Projects". "Large Public Works" is based upon the current threshold required for bidding Public Works as set by the Purchasing and Contracting Advisory Council.

ARTICLE 4: ADMINISTRATION OF THE CONTRACT

4.1 CONTRACT SURETY

4.1.1 PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

4.1.2 All bonds will be required as follows unless specifically waived elsewhere in the Bidding Documents.

4.1.3 Contents of Performance Bonds – The bond shall be in the form approved by the Office of Management and Budget. 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, plans, specifications, and bid documents thereof. Each term and condition shall be met at the time and in the manner prescribed by the Contract, Bid documents and the specifications, including the payment in full to every person furnishing materiel or performing labor in the performance of the Contract, of all sums of money due the person for such labor and materiel. (The bond shall also contain the successful bidder's guarantee to indemnify and save harmless the State and the agency from all costs, damages and expenses growing out of or by reason of the Contract in accordance with the Contract.)

4.1.4 Invoking a Performance Bond – The agency may, when it considers that the interest of the State so require, cause judgement to be confessed upon the bond.

4.1.5 Within twenty (20) days after the date of notice of award of contract, the Bidder to whom the award is made shall furnish a Performance Bond and Labor and Material Payment Bond, each equal to the full amount of the Contract price to guarantee the faithful performance of all terms, covenants and conditions of the same. The bonds are to be issued by an acceptable Bonding Company licensed to do business in the State of Delaware and shall be issued in duplicate.

4.1.6 Performance and Payment Bonds shall be maintained in full force (warranty bond) for a period of two (2) years after the date of the Certificate for Final Payment. The Performance Bond shall guarantee the satisfactory completion of the Project and that the Contractor will make good any faults or defects in his work which may develop during the period of said guarantees as a result of improper or defective workmanship, material or apparatus, whether furnished by themselves or their Sub-Contractors. The Payment Bond shall guarantee that the Contractor shall pay in full all persons, firms or corporations who furnish labor or material or both labor and material for, or on account of, the work included herein. The

bonds shall be paid for by this Contractor. The Owner shall have the right to demand that the proof parties signing the bonds are duly authorized to do so.

4.2 FAILURE TO COMPLY WITH CONTRACT

4.2.1 If any firm entering into a contract with the State, or Agency that neglects or refuses to perform or fails to comply with the terms thereof, the Agency which signed the Contract may terminate the Contract and proceed to award a new contract in accordance with this Chapter 69, Title 29 of the Delaware Code or may require the Surety on the Performance Bond to complete the Contract in accordance with the terms of the Performance Bond. Nothing herein shall preclude the Agency from pursing additional remedies as otherwise provided by law.

4.3 CONTRACT INSURANCE AND CONTRACT LIABILITY

4.3.1 In addition to the bond requirements stated in the Bid Documents, each successful Bidder shall purchase adequate insurance for the performance of the Contract and, by submission of a Bid, agrees to indemnify and save harmless and to defend all legal or equitable actions brought against the State, any Agency, officer and/or employee of the State, for and from all claims of liability which is or may be the result of the successful Bidder's actions during the performance of the Contract.

4.3.2 The purchase or nonpurchase of such insurance or the involvement of the successful Bidder in any legal or equitable defense of any action brought against the successful Bidder based upon work performed pursuant to the Contract will not waive any defense which the State, its agencies and their respective officers, employees and agents might otherwise have against such claims, specifically including the defense of sovereign immunity, where applicable, and by the terms of this section, the State and all agencies, officers and employees thereof shall not be financially responsible for the consequences of work performed, pursuant to said contract.

4.4 RIGHT TO AUDIT RECORDS

4.4.1 The Owner 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.

4.4.2 Said books and records shall be maintained by the Contractor for a period of seven (7) years from the date of final payment under the Prime Contract and by the Subcontractor for a period of seven (7) years from the date of final payment under the Subcontract.

ARTICLE 5: SUBCONTRACTORS

5.1 SUBCONTRACTING REQUIREMENTS

5.1.1 All contracts for the construction, reconstruction, alteration or repair of any public building (not a road, street or highway) shall be subject to the following provisions:

1. A contract shall be awarded only to a Bidder whose Bid is accompanied by a statement containing, for each Subcontractor category, the name and address

(city or town and State only – street number and P.O. Box addresses not required) of the subcontractor whose services the Bidder intends to use in performing the Work and providing the material for such Subcontractor category.

2. A Bid will not be accepted nor will an award of any Contract be made to any Bidder which, as the Prime Contractor, has listed itself as the Subcontractor for any Subcontractor unless:

A. It has been established to the satisfaction of the awarding Agency that the Bidder has customarily performed the specialty work of such Subcontractor category by artisans regularly employed by the Bidder's firm;

B. That the Bidder is duly licensed by the State to engage in such specialty work, if the State requires licenses; and

C. That the Bidder is recognized in the industry as a bona fide Subcontractor or Contractor in such specialty work and Subcontractor category.

5.1.2 The decision of the awarding Agency as to whether a Bidder who list itself as the Subcontractor for a Subcontractor category shall be final and binding upon all Bidders, and no action of any nature shall lie against any awarding agency or its employees or officers because of its decision in this regard.

5.1.3 After such a Contract has been awarded, the successful Bidder 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 the awarding Agency.

5.1.4 No Agency shall consent to any substitution of Subcontractors unless the Agency is satisfied that the Subcontractor whose name is on the Bidders accompanying statement:

A. Is unqualified to perform the work required;

B. Has failed to execute a timely reasonable Subcontract;

C. Has defaulted in the performance on the portion of the work covered by the Subcontract; or

D. Is no longer engaged in such business.

5.1.5 Should a Bidder be awarded a contract, such successful Bidder shall provide to the agency the taxpayer identification license numbers of such subcontractors. Such numbers shall be provided on the later of the date on which such subcontractor is required to be identified or the time the contract is executed. The successful Bidder shall provide to the agency to which it is contracting, within 30 days of entering into such public works contract, copies of all Delaware Business licenses of subcontractors and/or independent contractors that will perform work for such public works contract. However, if a subcontractor or independent contractor is hired or contracted more than 20 days after the Bidder entered the public works contract the Delaware Business license of such subcontractor or independent contractor shall be provided to the agency within 10 days of being contracted or hired.

5.1.6 The Contractor may employ additional Subcontractors on the jobsite only after submitting a copy of the Subcontractor's Employee Drug Testing Program to the Owner for approval. A Contractor or Subcontractor shall not commence work until the Owner has concluded its review and determined that the submitted Employee Drug Testing Program complies with OMB Regulation 4104.

5.2 PENALTY FOR SUBSTITUTION OF SUBCONTRACTORS

5.2.1 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 payments 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 contract amount not to exceed $10,000

5.3 ASBESTOS ABATEMENT

5.3.1 The selection of any Contractor to perform asbestos abatement for State-funded projects shall be approved by the Office of Management and Budget, Division of Facilities Management pursuant to Chapter 78 of Title 16.

5.4 STANDARDS OF CONSTRUCTION FOR THE PROTECTION OF THE PHYSICALLY HANDICAPPED

5.4.1 All Contracts shall conform with the standard established by the Delaware Architectural Accessibility Board unless otherwise exempted by the Board.

5.5 CONTRACT PERFORMANCE

5.5.1 Any firm entering into a Public Works Contract that neglects or refuses to perform or fails to comply with its terms, the Agency may terminate the Contract and proceed to award a new Contract or may require the Surety on the Performance Bond to complete the Contract in accordance with the terms of the Performance Bond.

ARTICLE 6: CONSTRUCTION BY OWNER OR SEPARATE CONTRACTORS

6.1 The Owner reserves the right to simultaneously perform other 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 Projects at the same site.

6.2 The Contractor shall afford the Owner and other Contractors reasonable opportunity for access and storage of materials and equipment, and for the performance of their activities,

and shall connect and coordinate their activities with other forces as required by the Contract Documents.

ARTICLE 7: CHANGES IN THE WORK

7.1 The Owner, without invalidating the Contract, may order changes in the Work consisting of Additions, Deletions, Modifications or Substitutions, with the Contract Sum and Contract completion date being adjusted accordingly. Such changes in the Work shall be authorized by written Change Order signed by the Professional, as the duly authorized agent, the Contractor and the Owner.

7.2 The Contract Sum and Contract Completion Date shall be adjusted only by a fully executed Change Order.

7.3 The additional cost, or credit to the Owner resulting from a change in the Work shall be by mutual agreement of the Owner, Contractor and the Architect. In all cases, this cost or credit shall be based on the 'DPE' wages required and the "invoice price" of the materials/equipment needed.

7.3.1 "DPE" shall be defined to mean "direct personnel expense". Direct payroll expense includes prevailing wage rates plus a maximum multiplier of 1.35 times DPE. For example, if the prevailing wage rate is $50/hour, the DPE would be $67.50/hour (50 x 1.35).

7.3.2 "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. Rates for equipment that is leased and/or owned by the Contractor or subcontractor(s) shall not exceed those listed in the latest version of the "Means Building Construction Cost Data" publication.

7.3.3 In addition to the above, the General Contractor is allowed a fifteen percent (15%) markup for overhead and profit for additional work performed by the General Contractor's own forces. For additional subcontractor work, the Subcontractor is allowed a fifteen (15) percent overhead and profit on change order work above and beyond the direct costs stated previously. To this amount, the General Contractor will be allowed a mark-up not exceeding seven and one half percent (7.5%) on the subcontractors work. These mark-ups shall include all costs including, but not limited to: overhead, profit, bonds, insurance, supervision, etc. No markup is permitted on the work of the subcontractors subcontractor. No additional costs shall be allowed for changes related to the Contractor's onsite superintendent/staff, or project manager, unless a change in the work changes the project duration and is identified by the CPM schedule. There will be no other costs associated with the change order.

ARTICLE 8: TIME

8.1 Time limits, if any, are as stated in the Project Manual. By executing the Agreement, the Contractor confirms that the stipulated limits are reasonable, and that the Work will be completed within the anticipated time frame.

8.2 If progress of the Work is delayed at any time by changes ordered by the Owner, by labor disputes, fire, unusual delay in deliveries, abnormal adverse weather conditions, unavoidable

casualties or other causes beyond the Contractor's control, the Contract Time shall be extended for such reasonable time as the Owner may determine.

8.3 Any extension of time beyond the date fixed for completion of the construction and acceptance of any part of the Work called for by the Contract, or the occupancy of the building by the Owner, in whole or in part, previous to the completion shall not be deemed a waiver by the Owner of his right to annul or terminate the Contract for abandonment or delay in the matter provided for, nor relieve the Contractor of full responsibility.

8.4 SUSPENSION AND DEBARMENT

8.4.1 Per Section 6962(d)(14), Title 29, Delaware Code, “Any Contractor who fails to perform a public works contract or complete a public works project within the time schedule established by the Agency in the Invitation To Bid, may be subject to Suspension or Debarment for one or more of the following reasons: a) failure to supply the adequate labor supply ratio for the project; b) inadequate financial resources; or, c) poor performance on the Project.”

8.4.2 “Upon such failure for any of the above stated reasons, the Agency that contracted for the public works project may petition the Director of the Office of Management and Budget for Suspension or Debarment of the Contractor. The Agency shall send a copy of the petition to the Contractor within three (3) working days of filing with the Director. If the Director concludes that the petition has merit, the Director shall schedule and hold a hearing to determine whether to suspend the Contractor, debar the Contractor or deny the petition. The Agency shall have the burden of proving, by a preponderance of the evidence, that the Contractor failed to perform or complete the public works project within the time schedule established by the Agency and failed to do so for one or more of the following reasons: a) failure to supply the adequate labor supply ratio for the project; b) inadequate financial resources; or, c) poor performance on the project. Upon a finding in favor of the Agency, the Director may suspend a Contractor from Bidding on any project funded, in whole or in part, with public funds for up to 1 year for a first offense, up to 3 years for a second offense and permanently debar the Contractor for a third offense. The Director shall issue a written decision and shall send a copy to the Contractor and the Agency. Such decision may be appealed to the Superior Court within thirty (30) days for a review on the record.”

8.5 RETAINAGE

8.5.1 Per Section 6962(d)(5) a.3, Title 29, Delaware Code: The Agency may at the beginning of each public works project establish a time schedule for the completion of the project. If the project is delayed beyond the completion date due to the Contractor’s failure to meet their responsibilities, the Agency may forfeit, at its discretion, all or part of the Contractor’s retainage.

8.5.2 This forfeiture of retainage also applies to the timely completion of the punchlist. A punchlist will only be prepared upon the mutual agreement of the Owner, Architect and Contractor. Once the punchlist is prepared, all three parties will by mutual agreement, establish a schedule for its completion. Should completion of the punchlist be delayed beyond the established date due to the Contractor’s failure to meet their responsibilities,

the Agency may hold permanently, at its discretion, all or part of the Contractor's retainage.

ARTICLE 9: PAYMENTS AND COMPLETION

9.1 APPLICATION FOR PAYMENT

9.1.1 Applications for payment shall be made upon AIA Document G702. There will be a five percent (5%) retainage on all Contractor's monthly invoices until completion of the project. This retainage may become payable upon receipt of all required closeout documentation, provided all other requirements of the Contract Documents have been met.

9.1.2 A date will be fixed for the taking of the monthly account of work done. Upon receipt of Contractor's itemized application for payment, such application will be audited, modified, if found necessary, and approved for the amount. Statement shall be submitted to the Owner.

9.1.3 Section 6516, Title 29 of the Delaware Code annualized interest is not to exceed 12% per annum beginning thirty (30) days after the "presentment" (as opposed to the date) of the invoice.

9.2 PARTIAL PAYMENTS

9.2.1 Any public works Contract executed by any Agency may provide for partial payments at the option of the Owner with respect to materials placed along or upon the sites or stored at secured locations, which are suitable for use in the performance of the contract.

9.2.2 When approved by the agency, partial payment may include the values of tested and acceptable materials of a nonperishable or noncontaminative nature which have been produced or furnished for incorporation as a permanent part of the work yet to be completed, provided acceptable provisions have been made for storage.

9.2.2.1 Any allowance made for materials on hand will not exceed the delivered cost of the materials as verified by invoices furnished by the Contractor, nor will it exceed the contract bid price for the material complete in place.

9.2.3 If requested by the Agency, receipted bills from all Contractors, Subcontractors, and material, men, etc., for the previous payment must accompany each application for payment. Following such a request, no payment will be made until these receipted bills have been received by the Owner.

9.3 SUBSTANTIAL COMPLETION

9.3.1 When the building has been made suitable for occupancy and met the requirements of substantial completion, but still requires small items of miscellaneous work, the Engineer will determine the date when the project has been substantially completed.

9.3.2 If, after the Work has been substantially completed, full completion thereof is materially delayed through no fault of the Contractor, and without terminating the Contract, the Owner may make payment of the balance due for the portion of the Work fully completed and accepted. Such payment shall be made under the terms and conditions governing final payment that it shall not constitute a waiver of claims.

9.3.3 On projects where commissioning is included, the commissioning work as defined in the specifications must be complete prior to the issuance of substantial completion.

9.4 FINAL PAYMENT

9.4.1 Final payment, including the five percent (5%) retainage if determined appropriate, shall be made within thirty (30) days after the Work is fully completed and the Contract fully performed and provided that the Contractor has submitted the following closeout documentation (in addition to any other documentation required elsewhere in the Contract Documents):

9.4.1.1 Evidence satisfactory to the Owner that all payrolls, material bills, and other indebtedness connected with the work have been paid,

9.4.1.2 An acceptable RELEASE OF LIENS,

9.4.1.3 Copies of all applicable warranties,

9.4.1.4 As-built drawings,

9.4.1.5 Operations and Maintenance Manuals,

9.4.1.6 Instruction Manuals,

9.4.1.7 Consent of Surety to final payment.

9.4.1.8 The Owner reserves the right to retain payments, or parts thereof, for its protection until the foregoing conditions have been complied with, defective work corrected and all unsatisfactory conditions remedied.

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

10.1 The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract. The Contractor shall take all reasonable precautions to prevent damage, injury or loss to: workers, persons nearby who may be affected, the Work, materials and equipment to be incorporated, and existing property at the site or adjacent thereto. The Contractor shall give notices and comply with applicable laws ordinances, rules regulations, and lawful orders of public authorities bearing on the safety of persons and property and their protection from injury, damage, or loss. The Contractor shall promptly remedy damage and loss to property at the site caused in whole or in part by the Contractor, a Subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable.

10.2 The Contractor shall notify the Owner in the event any existing hazardous material such as lead, PCBs, asbestos, etc. is encountered on the project. The Owner will arrange with a qualified specialist for the identification, testing, removal, handling and protection against exposure or environmental pollution, to comply with applicable regulation laws and ordinances. The Contractor and Architect will not be required to participate in or to perform this operation. Upon completion of this work, the Owner will notify the Contractor and

Architect in writing the area has been cleared and approved by the authorities in order for the work to proceed. The Contractor shall attach documentation from the authorities of said approval.

10.3 As required in the Hazardous Chemical Information Act of June 1984, all vendors supplying any materials that may be defined as hazardous, must provide Material Safety Data Sheets for those products. Any chemical product should be considered hazardous if it has a warning caution on the label relating to a potential physical or health hazard, if it is known to be present in the work place, and if employees may be exposed under normal conditions or in any foreseeable emergency situation. Material Safety Data Sheets must be provided directly to the Owner along with the shipping slips that include those products.

10.4 The Contractor shall certify to the Owner that materials incorporated into the Work are free of all asbestos. This certification may be in the form of Material Safety Data Sheet (MSDS) provided by the product manufacturer for the materials used in construction, as specified or as provided by the Contractor.

ARTICLE 11: INSURANCE AND BONDS

11.1 The Contractor shall carry all insurance required by law, such as Unemployment Insurance, etc. The Contractor shall carry such insurance coverage as they desire on their own property such as a field office, storage sheds or other structures erected upon the project site that belong to them and for their own use. The Subcontractors involved with this project shall carry whatever insurance protection they consider necessary to cover the loss of any of their personal property, etc.

11.2 Upon being awarded the Contract, the Contractor shall obtain a minimum of two (2) copies of all required insurance certificates called for herein, and submit one (1) copy of each certificate, to the Owner, within 20 days of contract award.

11.3 Bodily Injury Liability and Property Damage Liability Insurance shall, in addition to the coverage included herein, include coverage for injury to or destruction of any property arising out of the collapse of or structural injury to any building or structure due to demolition work and evidence of these coverages shall be filed with and approved by the Owner.

11.4 The Contractor's Property Damage Liability Insurance shall, in addition to the coverage noted herein, include coverage on all real and personal property in their care, custody and control damaged in any way by the Contractor or their Subcontractors during the entire construction period on this project.

11.5 Builders Risk (including Standard Extended Coverage Insurance) on the existing building during the entire construction period, shall not be provided by the Contractor under this contract. The Owner shall insure the existing building and all of its contents and all this new alteration work under this contract during entire construction period for the full insurable value of the entire work at the site. Note, however, that the Contractor and their Subcontractors shall be responsible for insuring building materials (installed and stored) and their tools and equipment whenever in use on the project, against fire damage, theft, vandalism, etc.

11.6 Certificates of the insurance company or companies stating the amount and type of coverage, terms of policies, etc., shall be furnished to the Owner, within 20 days of contract award.

11.7 The Contractor shall, at their own expense, (in addition to the above) carry the following forms of insurance:

11.7.1 Contractor's Contractual Liability Insurance

Minimum coverage to be:

Bodily Injury	$500,000	for each person
	$1,000,000	for each occurrence
	$1,000,000	aggregate
Property Damage	$500,000	for each occurrence
	$1,000,000	aggregate

11.7.2 Contractor's Protective Liability Insurance

Minimum coverage to be:

Bodily Injury	$500,000	for each person
	$1,000,000	for each occurrence
	$1,000,000	aggregate
Property Damage	$500,000	for each occurrence
	$500,000	aggregate

11.7.3 Automobile Liability Insurance

Minimum coverage to be:

Bodily Injury	$1,000,000	for each person
	$1,000,000	for each occurrence
Property Damage	$500,000	per accident

11.7.4 Prime Contractor's and Subcontractors' policies shall include contingent and contractual liability coverage in the same minimum amounts as 11.7.1 above.

11.7.5 Workmen's Compensation (including Employer's Liability):

11.7.5.1 Minimum Limit on employer's liability to be as required by law.

11.7.5.2 Minimum Limit for all employees working at one site.

11.7.6 Certificates of Insurance must be filed with the Owner guaranteeing fifteen (15) days prior notice of cancellation, non-renewal, or any change in coverages and limits of liability shown as included on certificates.

11.7.7 Social Security Liability

11.7.7.1 With respect to all persons at any time employed by or on the payroll of the Contractor or performing any work for or on their behalf, or in connection with or arising out of the Contractor's business, the Contractor shall accept full and exclusive liability for the payment of any and all contributions or taxes or unemployment insurance, or old age retirement benefits, pensions or annuities now or hereafter imposed by the Government of the United States and the State or political subdivision thereof, whether the same be measured by wages, salaries or other remuneration paid to such persons or otherwise.

11.7.7.2 Upon request, the Contractor shall furnish Owner such information on payrolls or employment records as may be necessary to enable it to fully comply with the law imposing the aforesaid contributions or taxes.

11.7.7.3 If the Owner is required by law to and does pay any and/or all of the aforesaid contributions or taxes, the Contractor shall forthwith reimburse the Owner for the entire amount so paid by the Owner.

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

12.1 The Contractor shall promptly correct Work rejected by the Owner or failing to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed, and shall correct any Work found to be not in accordance with the requirements of the Contract Documents within a period of two years from the date of Substantial Completion, or by terms of an applicable special warranty required by the Contract Documents. The provisions of this Article apply to work done by Subcontractors as well as to Work done by direct employees of the Contractor.

12.2 At any time during the progress of the work, or in any case where the nature of the defects shall be such that it is not expedient to have them corrected, the Owner, at their option, shall have the right to deduct such sum, or sums, of money from the amount of the contract as they consider justified to adjust the difference in value between the defective work and that required under contract including any damage to the structure.

ARTICLE 13: MISCELLANEOUS PROVISIONS

13.1 CUTTING AND PATCHING

13.1.1 The Contractor shall be responsible for all cutting and patching. The Contractor shall coordinate the work of the various trades involved.

13.2 DIMENSIONS

13.2.1 All dimensions shown shall be verified by the Contractor by actual measurements at the project site. Any discrepancies between the drawings and specifications and the existing conditions shall be referred to the Owner for adjustment before any work affected thereby has been performed.

13.3 LABORATORY TESTS

13.3.1 Any specified laboratory tests of material and finished articles to be incorporated in the work shall be made by bureaus, laboratories or agencies approved by the Owner and reports of

such tests shall be submitted to the Owner. The cost of the testing shall be paid for by the Contractor.

13.3.2 The Contractor shall furnish all sample materials required for these tests and shall deliver same without charge to the testing laboratory or other designated agency when and where directed by the Owner.

13.4 ARCHAEOLOGICAL EVIDENCE

13.4.1 Whenever, in the course of construction, any archaeological evidence is encountered on the surface or below the surface of the ground, the Contractor shall notify the authorities of the State Historic Preservation Office and suspend work in the immediate area for a reasonable time to permit those authorities, or persons designated by them, to examine the area and ensure the proper removal of the archaeological evidence for suitable preservation by the Division of Historical and Cultural Affairs.

13.5 GLASS REPLACEMENT AND CLEANING

13.5.1 The General Contractor shall replace without expense to the Owner all glass broken during the construction of the project. If job conditions warrant, at completion of the job the General Contractor shall have all glass cleaned and polished.

13.6 WARRANTY

13.6.1 For a period of two (2) years from the date of substantial completion, as evidenced by the date of final acceptance of the work, the contractor warrants that work performed under this contract conforms to the contract requirements and is free of any defect of equipment, material or workmanship performed by the contractor or any of his subcontractors or suppliers. However, manufacturer's warranties and guarantees, if for a period longer than two (2) years, shall take precedence over the above warranties. The contractor shall remedy, at his own expense, any such failure to conform or any such defect. The protection of this warranty shall be included in the Contractor's Performance Bond.

ARTICLE 14: TERMINATION OF CONTRACT

14.1 If the Contractor defaults or persistently fails or neglects to carry out the Work in accordance with the Contract Documents or fails to perform a provision of the Contract, the Owner, after seven days written notice to the Contractor, may make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor. Alternatively, at the Owner's option, and the Owner may terminate the Contract and take possession of the site and of all materials, equipment, tools, and machinery thereon owned by the Contractor and may finish the Work by whatever method the Owner may deem expedient. If the costs of finishing the Work exceed any unpaid compensation due the Contractor, the Contractor shall pay the difference to the Owner.

14.2 “If the continuation of this Agreement is contingent upon the appropriation of adequate state, or federal funds, this Agreement may be terminated on the date beginning on the first fiscal year for which funds are not appropriated or at the exhaustion of the appropriation. The Owner may terminate this Agreement by providing written notice to the parties of such non-appropriation. All payment obligations of the Owner will cease

upon the date of termination. Notwithstanding the foregoing, the Owner agrees that it will use its best efforts to obtain approval of necessary funds to continue the Agreement by taking appropriate action to request adequate funds to continue the Agreement."

END OF GENERAL REQUIREMENTS

DRUG TESTING FORMS

Pursuant to 4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors who work on Large Public Works Contracts funded all or in part with public funds submit Testing Report Forms to the Owner no less than quarterly. See the form attached hereto.

The Contractor will notify the Owner in writing of any positive results of random drug testing. See the form attached hereto. The results must be reported to the Owner within 24 hours of receipt of the test results.

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DRUG TESTING FORMS

EMPLOYEE DRUG TESTING REPORT FORM
Period Ending:

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors who work on Large Public Works Contracts funded all or in part with public funds submit Testing Report Forms to the Owner no less than quarterly.

Project Number: _____

Project Name: _____

Contractor/Subcontractor Name: _____

Contractor/Subcontractor Address: _____

_____

_____

Number of employees who worked on the jobsite during the report period:_____

Number of employees subject to random testing during the report period:_____

Number of Negative Results _____Number of Positive Results _____

Action taken on employee(s) in response to a failed or positive random test:

_____

_____

Authorized Representative of Contractor/Subcontractor: _____
(typed or printed)

Authorized Representative of Contractor/Subcontractor: _____
(signature)

Date: _____

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EMPLOYEE DRUG TESTING
REPORT OF POSITIVE RESULTS

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors who work on Large Public Works Contracts funded all or in part with public funds to notify the Owner in writing of a positive random drug test.

Project Number: _____

Project Name: _____

Contractor/Subcontractor Name: _____

Contractor/Subcontractor Address: _____

_____

_____

Name of employee with positive test result: _____

Last 4 digits of employee SSN:_____

Date test results received:_____

Action taken on employee in response to a positive test result:

_____

_____

_____

Authorized Representative of Contractor/Subcontractor:_____
(typed or printed)

Authorized Representative of Contractor/Subcontractor:_____
(signature)

Date: _____

This form shall be sent by mail to the Owner within 24 hours of receipt of test results.

Enclose this test results form in a sealed envelope with the notation "Drug Testing Form – DO NOT OPEN" on the face thereof and place in a separate mailing envelope.

END OF SECTION

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4000 Office of Management and Budget
4100 Division of Facilities Management

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects

1.0 Purpose

The Office of Management and Budget ("Office"), has developed these regulations that require Contractors and Subcontractors to implement a program of mandatory drug testing for Employees who work on Large Public Works Contracts funded all or in part with public funds pursuant to 29 **Del.C.** §6908(a)(6). The regulations establish the mechanism, standards and requirements of a Mandatory Drug Testing Program that will be incorporated by reference into all Large Public Works Contracts awarded pursuant to 29 **Del.C.** §6962.

2.0 Definitions

"**Contractor**" means an entity such as, but not limited to, an individual, firm, partnership or corporation that has a contractual obligation to perform work for contracts awarded pursuant to 29 **Del.C.** §6962.

"**Division of Facilities Management**" and "**DFM**" means the Division of Facilities Management within the Office of Management and Budget.

"**Drug Testing Firm**" is an entity engaged in the business of providing drug testing services for businesses, individuals, governments or any entity that requires drug testing of Employees, applicants, licensees, etc., in compliance with these requirements.

"**Employee**" means an individual employed by a Contractor or Subcontractor who works on the Jobsite of a Large Public Works Contract but does not fulfill a clerical or administrative function. For the purpose of this definition, clerical or administrative functions shall refer to job responsibilities that do not generally require an employee to work outside of the Contractor's Jobsite office, home office or other employer-provided office. For the purposes of this regulation, the term "Employee" shall also include supervisors and foremen working on the Jobsite. The term "Employee" shall also include delivery personnel employed by a Contractor or Subcontractor working on or delivering materials and equipment to and from a Jobsite.

"**Impairment**" **or** "**Impaired**" means symptoms that an Employee while working may be under the influence of drugs or alcohol that may decrease or lessen the Employee's performance of the duties or tasks of the Employee's job position, including symptoms of the Employee's speech, walking, standing, physical dexterity, agility, coordination, actions, movement, demeanor, appearance, clothing, odor, irrational or unusual behavior, negligence or carelessness in operating equipment, machinery or production or manufacturing processes, disregard for the safety of the Employee or others, or other symptoms causing a reasonable suspicion of the use of drugs or alcohol.

"**Jobsite**" means the site or area directly or indirectly owned, operated or controlled by the Owner in which the Contractor or Subcontractor performs work or delivers services to the Owner. For the purpose of this definition, "Jobsite" does not mean a remote work site not under the direct or indirect control of the Owner in which work is performed to fulfill the Contractor's or Subcontractor's obligations.

"**Large Public Works Contract**" means a contract for a public works construction awarded pursuant to 29 **Del.C.** §6962.

"**Mandatory Drug Testing Program**" and "**Program**" means a defined set of basic procedures, requirements and rules that must be used by a Contractor or Subcontractor to test Employees for drugs in compliance with these requirements.

"**Owner**" is the state agency, school district or entity that awards a Large Public Works Contract to a Contractor pursuant to 29 **Del.C.** §6962.

"**Positive Test Result**" and "**Fail a Drug Test**" means the result reported by a Health and Human Services certified laboratory when a specimen contains a drug or drug metabolite equal to or greater than the cutoff concentration. For purposes of these regulations, an Employee shall not be considered to have a Positive Test Result nor shall an Employee be considered to "Fail a Drug Test" if:

- The Employee is a Registered Qualifying Patient and;
- The drug detected was marijuana, a component of marijuana, or marijuana metabolites.

"**Random Drug Testing**" means that an Employee is chosen at random for testing without advance notice, from a pool of Employees working on the Jobsite. Specific requirements for random drug testing conducted under these regulations are described in Section 5.0.

"**Registered Qualifying Patient**" means a person (1) validly issued and in possession of an unexpired Registry Identification Card as defined by 16 **Del.C.** §4902A (14), and (2) subject to confirmation through a "verification system" as set forth at 16 **Del.C.** §4902A(17).

"**Subcontractor**" means an entity such as, but not limited to, an individual, firm, partnership or corporation that has a contractual obligation to perform work for, or supply services to a Contractor as defined in section 2.1.

"**Testing Result Forms**" means a form summarizing drug testing completed monthly by the Contractor and Subcontractor and submitted to the Owner in accordance with requirements contained in the bid solicitation.

3.0 Employee drug testing documentation requirements.

3.1 The following documentation requirements apply:

3.1.1 At bid submission - A solicitation for a Large Public Works Contract must require each Contractor that submits a bid for the work to submit with the bid signed individual affadavit(s) for the Contractor and each listed Subcontractor certifying that the Contractor and Subcontractor has in place or will implement during the entire term of the contract a Mandatory Drug Testing Program for their Employees that complies with this regulation.

3.1.2 Two business days prior to contract execution – The awarded Contractor shall provide to the Owner copies of the Employee Drug Testing Program for the Contractor and for all listed Subcontractors.

3.1.3 During contract execution – Contractors that employ additional Subcontractors on the jobsite may do so only after submitting a copy of the Subcontractor's Employee Drug Testing Program. A Contractor or Subcontractor shall not commence work until the Owner has concluded the Employee Drug Testing Program complies with this Regulation as per Section 3.2.

3.1.4 In the event of an emergency a Contractor may employ additional Subcontractors on the jobsite prior to submitting the Subcontractor's Employee Drug Testing Program provided that said Program is submitted to the Owner as soon as practicable.

3.2 A Contractor or Subcontractor shall be treated as having a Mandatory Drug Testing Program that complies with this regulation if the Program includes the following:

3.2.1 The Program meets the minimum standards in section 4.0 of this regulation.

3.2.2 The Program provides for the frequency of testing of Employees as per section 5.0 of this regulation:

3.2.3 The Program imposes disciplinary measures on an Employee who fails a drug test as per section 6.0 of this regulation.

3.3 Prequalified Contractors and Subcontractors – A Contractor or Subcontractor may meet the provisions of Section 3.1 if they are Prequalified through the DFM Prequalification and if the DFM Prequalification includes provisions requiring an Employee Mandatory Drug Testing Program that meet the requirements of Sections 4.0, 5.0 and 6.0 of this Regulation

3.4 The State shall not be obligated to pay, and the Contractor or Subcontractor shall expressly agree that, any portion of work performed by a Contractor or Subcontractor commenced before that Contractor or Subcontractor has complied with Sections 3.1 and 3.2, provided however that emergency work as referenced in 3.1.4 may not be subject to this provision.

4.0 Minimum Standards for a Mandatory Drug Testing Program

4.1 Testing for the presence of drugs in an Employee's system and the handling of test specimens shall be conducted in accordance with guidelines for the collection, chain-of-custody procedures, laboratory testing, and Medical Officer Review procedures contained within the Mandatory Guidelines for Federal Workplace Drug Testing Programs published by the Substance Abuse and Mental Health Services Administration (SAMHSA). http://workplace.samhsa.gov/DrugTesting/Level_1_Pages/mandatory_guidelines5_1_10.html

All tests must be processed by a federal Health and Human Services certified laboratory. Contractors must provide documentation detailing the procedures used in the collection, testing and reporting of drug tests sufficient to show conformance with SAMHSA guidelines.

4.2 Contractors and Subcontractors subject to these regulations may procure the services of an appropriate Drug Testing Firm to administer their program. A Contractor or Subcontractor may also implement a Mandatory Drug

Testing Program using in-house personnel and resources. However a Contractor or Subcontractor doing so shall have to demonstrate that the program meets or exceeds the requirements specified herein to the satisfaction of the Owner.

4.3 Employees subject to drug testing shall be tested using at a minimum a seven-panel protocol testing plus alcohol screening for the following:

Substance	Common Name	Cutoff
Marijuana metabolite		50 ng/ml
Cocaine metabolite		150 ng/ml
Opiate metabolite		2000 ng/ml
Acetylmorphine	Heroin metabolite	10 ng/ml
Phencyclidine	PCP	25 ng/ml
Amphetamines (including Methamphetamines)	Meth	500 ng/ml
MDMA	Ecstasy	250 ng/ml
Alcohol		0.04% BAC

4.4 The frequency of Random Drug Testing and the methodology for selecting Employees to be screened are defined in section 5.0 and shall be incorporated into Contractor and Subcontractor mandatory testing procedures. A Contractor or Subcontractor may incorporate rules or requirements that exceed the requirements defined herein.

5.0 Drug Testing Requirements – Frequency for the Testing of Employees

5.1 Initial Drug Testing - Employees commencing work on a Jobsite must be tested with the exception that an Employee who has passed a random or scheduled drug test within the past 60 days from the date of commencing work shall be permitted to work at the Jobsite without further testing; however, the Employee is still subject to random testing.

5.2 Random Drug Testing - During the course of a project, each Contractor and Subcontractor with Employees on the Jobsite shall implement Random Drug Testing according to the following requirements.

5.2.1 All Employees will be subject to random, unannounced testing.

5.2.2 The selection of Employees shall be made by a scientifically valid method of randomly generating an Employee identifier from a Contractor or Sub-contractor's pool of Employees.

5.2.3 No less that 10% of a Contractor's or Subcontractor's anticipated workforce based on construction schedules validated by certified payrolls shall be randomly selected each month for testing. Contractors or Subcontractors with less than 10 Employees shall test at least one of their Employees, selected randomly per month. Each Employee shall have an equal chance of selection each time the selection is made. Because the selection process is random, some Employees may not be tested within a year, while others may be tested more than once.

5.2.4 Employees notified that they have been selected must report within four hours for testing to a site specified. Employees so notified must have been given such notification at least four hours before the scheduled closing time of the testing facility. Any failure to report for random testing, or to cooperate with the testing procedure shall be considered a positive result.

5.2.5 Purposely impeding or delaying an Employee's fulfillment of the testing requirements herein by a Contractor or Subcontractor may subject the Contractor or Subcontractor to sanctions listed in Section 8.

5.3 Reasonable Suspicion Testing – An Employee will be required to take a drug test at any time his or her employing Contractor, Subcontractor or the Owner reasonably believes that he or she has an Impairment caused by drugs and/or alcohol. Further, an Employee may be required to take a drug test at any time his or her employing Contractor, Subcontractor or the Owner finds drug paraphernalia and/or open alcohol containers on the Jobsite.

5.4 Return to Duty Testing – As required in Section 6.0.

5.5 Accident Triggered Testing – An Employee will be required to take a drug test and may be subject to an onsite alcohol breathalyzer test at any time there is a Jobsite accident involving loss or significant property damage, injury or death to an Employee of the Contractor, Subcontractor, or Owner or member of the public.

5.5.1 As soon as practicable following an accident, the Contractor will notify the Employee(s) whose performance could have contributed to the accident of the need for the test.

5.5.2 The appropriate Contractor shall ensure that an Employee, required to be tested under this section, is tested as soon as practicable, but no longer than 4 hours after the accident. Employees so notified must have been given such notification at least four hours before the scheduled closing time of the testing facility. If the drug test is not conducted within 4 hours, attempts to conduct the test must cease and the reasons for the failure to test documented.

5.5.3 An Employee who is subject to post-accident testing who fails to remain readily available for such testing, including notifying a supervisor of his or her location if he or she leaves the scene of the accident prior to submission to such test, may be deemed to have refused to submit to testing.

5.5.4 If an Employee fails or refuses to be tested, he/she must be removed from the Jobsite.

5.5.5 Nothing in this section shall be construed to require the delay of necessary medical attention for the injured following an accident, or to prohibit an Employee from leaving the scene of an accident for the period necessary to obtain assistance in responding to the accident, or to obtain necessary emergency medical care.

5.6 All testing required by this section shall be administered according to the standards outlined in Section 4.0.

6.0 Consequences of a Positive Test Result

6.1 The disciplinary measures contained within a Contractor's or Subcontractor's drug testing program for an employee who tests positive to a mandatory drug test must include at a minimum, all of the following:

6.1.1 The Employee is subject to an immediate suspension from any public works Jobsite.

6.1.2 The Employee is not eligible for reinstatement by the Contractor or Subcontractor to any public works Jobsite until 30 days after the Employee tests negative on a seven drug panel plus alcohol test certified by a medical review officer.

6.1.3 The Employee is subject to unscheduled monthly random testing for at least one (1) year after reinstatement, or during the term of the Large Public Works Contract, whichever is less.

6.1.4 An Employee who has tested positive for more than one drug test within a three year period shall be permanently banned from working at public works Jobsites.

6.1.5 An Employee who has tested positive for marijuana, a component of marijuana, or marijuana metabolites and is a Registered Qualifying Patient shall be exempted from the disciplinary actions contained in this section unless:

6.1.5.1 The Employee was Impaired by marijuana at the Jobsite

6.1.5.2 Employment of the Registered Qualifying Patient would cause the Owner to lose monetary or licensing-related benefits under Federal law.

6.2 A Contractor or Subcontractor shall report the Positive Test Result to the Employee's professional licensing board, if applicable.

7.0 Contractor and Subcontractor Certification of Compliance with Regulations

7.1 During the term of the contract:

7.1.1 During the term of the contract, Contractors and Subcontractors shall submit Testing Report Forms to the Owner as set forth herein:

7.1.1.1 The Testing Report Forms shall be submitted to the Owner no less than quarterly.

7.1.1.2 An Owner may require monthly submissions of the Testing Report Forms.

7.1.1.3 A Contractor or Subcontractor that is employed on the Jobsite for less than 30 days shall not be subject to the reporting requirements contained in Sections 7.1.1 and 7.1.2 of this regulation, unless the Owner specifies that such reporting is required in the Invitation to Bid or Specifications relating to the work to be performed.

7.1.2 The forms shall at a minimum contain the following information:

7.1.2.1 The number of Employees who worked on the Jobsite during the previous month.

7.1.2.2 The number of Employees subjected to random testing during the previous month.

7.1.2.3 The number of negative results and the number of positive results.

7.1.2.4 Action taken by the Contractor or Subcontractor on an Employee who failed or tested positive to a random test.

7.1.3 Testing Result Forms may be submitted electronically to an Owner.

7.1.4 Any Positive Test Result including the Employee name and action taken in response by a Contractor or Subcontractor must be reported by the Contractor or Subcontractor to the Owner within 24 hours of the Contractor or Subcontractor receiving the test results. A Positive Test Result must be submitted to the Owner in writing.

7.1.5 The Owner shall have the right to periodically audit all Contractor and Subcontractor test results at the Contractor or Subcontractor's offices.

7.1.6 The failure to comply with these reporting requirements shall be considered a material breach of any agreement relating to the performance of work by the Contractor or Subcontractor.

8.0 Penalties

8.1 A Contractor or Subcontractor on a Large Public Works contract that fails to implement a Mandatory Drug Testing Program in accordance with this regulation or falsifies testing results shall be subject to the following sanctions:

8.1.1 Written warning (1st offense).

8.1.2 Prohibition from bidding on new public works jobs for a period not to exceed three months (2nd offense) and one year (3rd offense).

8.1.3 For subsequent offenses, debarment or bond revocation.

8.2 Notwithstanding any other provision of this regulation, if any failure to comply with the requirements of this regulation are particularly flagrant or egregious, the Owner may seek a termination for cause, a temporary suspension, a determination that the Contractor or Subcontractor is not responsible, debarment or bond revocation, and any other statutory, common law, or equitable remedy.

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SUMMARY OF WORK
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PART 1 GENERAL

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1.7 COORDINATION WITH OCCUPANTS
1.8 WORK RESTRICTIONS
1.9 SPECIFICATION AND DRAWING CONVENTIONS

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

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SECTION 01 11 00
SUMMARY OF WORK

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. Project information.
2. Work covered by Contract Documents.
3. Work by Owner.
4. Access to site.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and drawing conventions.

B. Related Section:

1. Division 01 Section 01 50 00 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

A. Project Identification: Delcastle High School Chiller/Cooling Tower Refurbishment

1. Project Location: Delcastle High School, 1417 Newport Road, Wilmington, DE 19808.

B. Owner: New Castle County Votech School District, 1417 Newport Road, Wilmington, DE 19804.
1. Owner's Representative: Al Schrum, Facilities Management Supervisor, 302-299-9106, a.schrum@nccvt.k12.de.us

C. M/E/P Engineer: Gipe Associates, Inc., 8719 Brooks Drive, Easton, MD 21601.
1. Engineer’s Representative: David R. Hoffman, P.E. President, 410-822-8688; dhoffman@gipe.net

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of the Project is defined by the Contract Documents and consists of the following:

1. The refurbishment of existing water cooled chiller and cooling tower, replacement of condenser water pump, and associated electrical work. Refer to project alternates.

B. Type of Contract

1. Project will be constructed under a single prime contract.

C. Work by specific vendors:

1. All chiller refurbishment work shall be performed by a York Certified Installer/Service Company.

1.5 WORK UNDER SEPARATE CONTRACTS

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract or other contracts. Coordinate the work of this Contract with work performed under separate contracts.

B. Concurrent Work: Owner will award separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.

1.6 ACCESS TO SITE

A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Limits: Confine construction operations to the Delcastle High School.
2. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

    a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
    b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with

completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1. Engineer will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.8 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.

B. All finishes and floor must be protected as indicated on Contract Drawing.

C. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:00 a.m. to 4:30 p.m., Monday through Friday, except as otherwise indicated.

1. Weekend Hours: (As approved by the Owner)
2. Early Morning Hours: (As approved by the Owner)
3. Hours for Utility Shutdowns: (As approved by the Owner)
4. Hours for Core Drilling and Other noisy activity: (As approved by the Owner)
5. Lifting, crane operations, and overhead work shall not occur while staff are in the facility.

D. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

1. Notify Owner not less than fourteen (14) days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.

E. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner not less than fourteen (14) days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

F. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet (8 m) of entrances, operable windows, or outdoor air intakes.

G. Controlled Substances: Use of tobacco products and other controlled substances within the existing building and on the Project site is not permitted.

H. Employee Identification: Provide identification tags for Contractor personnel working on the Project site. Require personnel to utilize identification tags at all times. Contractor must provide required information to the Owner to allow proper background checks.

I. Employee Screening: Comply with Owner's requirements regarding drug and background screening of Contractor personnel working on the Project site.

1. Maintain list of approved screened personnel with Owner's Representative.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 14 00
WORK RESTRICTIONS
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1.2 USE OF PREMISES
1.3 OCCUPANCY REQUIREMENTS

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

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SECTION 01 14 00
WORK RESTRICTIONS

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 USE OF PREMISES

A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated.

1. Limits: Confine constructions operations to the Delcastle High School.
2. Owner Occupancy: Allow for Owner occupancy of site.
3. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

    a. Schedule deliveries to minimize use of driveways and entrances.
    b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

B. Use of Existing Building: Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

C. Background Checks: All workers who perform work on the site shall be subject to a full background check.

D. HVAC and electrical work within the Delcastle High School area shall take place after chiller plant is de-energized for heating season.

E. Any crane/rigging work shall be completed when Delcastle High School is unoccupied during weekends or days when students are not on site.

F. Electrical shutdowns shall occur during weekends, holidays, and “off-hours” when the facility is not in use.

G. Testing of the chiller and cooling tower shall occur in the spring of 2020 when ambient temperature is above 85°F.

1.3 OCCUPANCY REQUIREMENTS

A. Full Owner Occupancy: Owner will occupy site and existing building during entire construction period. Cooperate with Owner during construction operations to minimize

conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 21 16
CONTINGENCY ALLOWANCES
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1.3 SELECTIONS AND PURCHASE
1.4 SUBMITTALS
1.5 COORDINATION
1.6 LUMP-SUM ALLOWANCES
1.7 CONTINGENCY ALLOWANCES
1.8 ADJUSTMENT OF ALLOWANCES

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 EXAMINATION
3.2 PREPARATION
3.3 SCHEDULE OF ALLOWANCES

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SECTION 01 21 16
CONTINGENCY ALLOWANCES

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 administrative and procedural requirements governing allowances.

1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to the Contractor. If necessary, additional requirements will be issued by Change Order.

B. Types of allowances include the following: Revise list below to suit Project.

1. Contingency allowances.

C. Related Sections:

1. Division 01 Section 01 40 00 "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.
2. Divisions 02 through 28 Sections for items of Work covered by allowances.

1.3 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Engineer of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.

B. At Engineer's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Engineer from the designated supplier.

1.4 SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

C. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

D. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.6 LUMP-SUM ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Engineer under allowance and shall include freight, and delivery to Project site.

B. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1. If requested by Engineer, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.7 CONTINGENCY ALLOWANCES

A. Use the contingency allowance only as directed by Engineer for Owner's purposes and only by Allowance Authorization Form (attached) that indicate amounts to be charged to the allowance.

B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, insurance, equipment rental, and similar costs.

C. Allowance Authorization Form authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.

D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.8 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.

3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1: Contingency Allowance: Include a contingency allowance of $20,000.00 Twenty Thousand Dollars for use according to Owner's instructions.

END OF SECTION

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SECTION 01 23 00
ALTERNATES
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PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 SCHEDULE OF ALTERNATES

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SECTION 01 23 00
ALTERNATES

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 administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.
3. The costs for alternates shall include additional Bonds and Insurance costs as a results of project value increasing if alternate is accepted.

1.4 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate #1– Cooling Tower Refurbishment and Condenser Water Pump Replacement

1. Alternate: Provide additional costs, if any, for all cooling tower refurbishment work as specified in Division 23. Work shall include cooling tower refurbishment, condenser water pump, tower fan variable frequency drive, associated power, and controls.

END OF SECTION

SECTION 01 25 00
SUBSTITUTION PROCEDURES
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1.6 PROCEDURES

PART 2 PRODUCTS

2.1 SUBSTITUTIONS

PART 3 EXECUTION (Not Used)

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SECTION 01 25 00
SUBSTITUTION PROCEDURES

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 administrative and procedural requirements for substitutions.

B. Related Sections:

1. Division 01 Section 01 21 16 "Contingency Allowances" for products selected under an allowance.
2. Division 01 Section 01 23 00 "Alternates" for products selected under an alternate.
3. Division 01 Section 01 60 00 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
4. Divisions 02 through 28 Sections for specific requirements and limitations for substitutions.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use CSI Form 13.1A.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable specification section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects with project names and addresses and names and addresses of engineers, architects, and owners.
h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project.
j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Engineer will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Engineer's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Engineer does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Modify or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately upon discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed, unless otherwise indicated.

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES
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1.4 PROPOSAL REQUESTS
1.5 ADMINISTRATIVE CHANGE ORDERS
1.6 CHANGE ORDER PROCEDURES
1.7 CONSTRUCTION CHANGE DIRECTIVE

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

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SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

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. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

B. Related Sections include the following:
   1. Division 01 Section 01 60 00 "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Engineer will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

   1. Proposal Requests issued by Engineer are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.

   2. Within (7) seven days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

      a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
      b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
      c. Include costs of labor and additional supervision directly attributable to the change.

d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Engineer.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Division 01 Section 01 60 00 "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

C. The Proposal Request shall include the Allowable Overhead and Profit Mark-Up scheduled in the General Conditions.

1.5 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: Refer to Division 01 Section 01 21 16 "Contingency Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

1.6 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, the Engineer will issue a Change Order for signatures of Owner, Contractor and Engineer.

1.7 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Engineer may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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PAYMENT PROCEDURES
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PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

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SECTION 01 29 00
PAYMENT PROCEDURES

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. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Sections include the following:

1. Division 01 Section 01 21 16 "Allowances" for procedural requirements governing the handling and processing of allowances.
2. Division 01 Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
3. Division 01 Section 01 32 00 "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.
4. Division 01 Section 01 33 00 "Submittal Procedures" for administrative requirements governing the preparation and submittal of submittal schedule.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.

1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:

a. Application for Payment forms with Continuation Sheets.
b. Submittals Schedule.
c. Contractor's Construction Schedule.

2. Submit the Schedule of Values to Engineer at earliest possible date but no later than the Work Initiation Conference.

3. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the Schedule of Values:

   a. Project name and location.
   b. Name of Engineer.
   c. Engineer's project number.
   d. Contractor's name and address.
   e. Date of submittal.

2. Submit draft of AIA Document G703 Continuation Sheets.

3. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:

   a. Related Specification Section or Division.
   b. Description of the Work.
   c. Name of subcontractor.
   d. Name of manufacturer or fabricator.
   e. Name of supplier.
   f. Change Orders (numbers) that affect value.
   g. Dollar value.

      1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.

5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

6. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

   a. Differentiate between items stored on-site and items stored off-site. If specified, include evidence of insurance or bonded warehousing.

7. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.

9. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.

10. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

11. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Engineer and paid for by Owner.

   1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Engineer will return incomplete applications without action.

   1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
   2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

   1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
   2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
   3. Provide summary documentation for stored materials indicating the following:

a. Materials previously stored and included in previous Applications for Payment.
b. Work completed for this Application utilizing previously stored materials.
c. Additional materials stored with this Application.
d. Total materials remaining stored, including materials with this Application.

F. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Engineer by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.

H. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of Values.
3. Contractor's Construction Schedule (preliminary if not final).
4. Products list.
5. Submittals Schedule (preliminary if not final).
6. List of Contractor's staff assignments.
7. List of Contractor's principal consultants.
8. Copies of building permits.
9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
10. Initial progress report.
11. Report of preconstruction conference.
12. Certificates of insurance and insurance policies.
13. Performance and payment bonds.
14. Data needed to acquire Owner's insurance.

J. Application for Payment at Substantial Completion and in accordance with the applicable sections in the College's General Terms and Conditions: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

K. Final Payment Application and in accordance with the applicable sections in the College's General Terms and Conditions: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

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SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION
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SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION

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. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General project coordination procedures.
2. Administrative and supervisory personnel.
3. Requests for Information (RFIs).
4. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.

C. Related Sections include the following:
1. Division 01 Section 01 32 00 "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule (Accepted Baseline and Monthly Updates).
2. Division 01 Section 01 73 00 "Execution Requirements" for procedures for coordinating general installation and field-engineering services.
3. Division 01 Section 01 77 00 "Closeout Procedures" for coordinating Contract closeout.

1.3 DEFINITIONS

A. RFI: Request from Owner, Engineer, or Contractor seeking information from each other during construction.

1.4 COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.
4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule (Accepted Baseline and Monthly Updates).
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Pre-installation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.5 KEY PERSONNEL

A. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.6 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Engineer will return RFIs submitted to Engineer by other entities controlled by Contractor with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Engineer.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: CSI Form 13.2A.

D. Engineer’s Action: Engineer will review each RFI, determine action required, and respond. Allow seven working days for Engineer's response for each RFI. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.

1. The following RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for coordination information already indicated in the Contract Documents.
    d. Requests for adjustments in the Contract Time or the Contract Sum.
    e. Requests for interpretation of Engineer's actions on submittals.
    f. Incomplete RFIs or inaccurately prepared RFIs.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt of additional information.
3. Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section 01 26 00 "Contract Modification Procedures."

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within 10 days of receipt of the RFI response.

E. On receipt of Engineer’s action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer within seven days if Contractor disagrees with response.

F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use CSI Log Form 13.2B. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Engineer.
4. RFI number including RFIs that were dropped and not submitted.
5. RFI description.
6. Date the RFI was submitted.
7. Date Engineer’s response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.7 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Engineer of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.

3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Engineer, within three days of the meeting.

B. Preconstruction Conference: Engineer will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Engineer, but no later than 15 days after execution of the Agreement.

1. Conduct the conference to review responsibilities and personnel assignments.
2. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Tentative construction schedule.
    b. Phasing.
    c. Critical work sequencing and long-lead items.
    d. Designation of key personnel and their duties.
    e. Lines of communications.
    f. Procedures for processing field decisions and Change Orders.
    g. Procedures for RFIs.
    h. Procedures for testing and inspecting.
    i. Procedures for processing Applications for Payment.
    j. Distribution of the Contract Documents.
    k. Submittal procedures.
    l. Preparation of record documents.
    m. Use of the premises and existing building.
    n. Work restrictions.
    o. Working hours.
    p. Owner's occupancy requirements.
    q. Responsibility for temporary facilities and controls.
    r. Procedures for moisture and mold control.
    s. Procedures for disruptions and shutdowns.
    t. Construction waste management and recycling.
    u. Parking availability.
    v. Office, work, and storage areas.
    w. Equipment deliveries and priorities.
    x. First aid.
    y. Security.
    z. Progress cleaning.

4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and

installations that have preceded or will follow, shall attend the meeting. Advise Engineer of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

    a. Contract Documents.
    b. Options.
    c. Related RFIs.
    d. Related Change Orders.
    e. Purchases.
    f. Deliveries.
    g. Submittals.
    h. Review of mockups.
    i. Possible conflicts.
    j. Compatibility problems.
    k. Time schedules.
    l. Weather limitations.
    m. Manufacturer's written recommendations.
    n. Warranty requirements.
    o. Compatibility of materials.
    p. Acceptability of substrates.
    q. Temporary facilities and controls.
    r. Space and access limitations.
    s. Regulations of authorities having jurisdiction.
    t. Testing and inspecting requirements.
    u. Installation procedures.
    v. Coordination with other work.
    w. Required performance results.
    x. Protection of adjacent work.
    y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct a Project closeout conference, at a time convenient to Owner and Engineer, but no later than 30 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

a. Preparation of record documents.
b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
c. Submittal of written warranties.
d. Requirements for preparing sustainable design documentation.
e. Requirements for preparing operations and maintenance data.
f. Requirements for demonstration and training.
g. Preparation of Contractor's punch list.
h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
i. Submittal procedures.
j. Coordination of separate contracts.
k. Owner's partial occupancy requirements.
l. Installation of Owner's furniture, fixtures, and equipment.
m. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Conduct progress meetings at regular intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Progress cleaning.
10) Quality and work standards.

11) Status of correction of deficient items.
12) Field observations.
13) Status of RFIs.
14) Status of proposal requests.
15) Pending changes.
16) Status of Change Orders.
17) Pending claims and disputes.
18) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

F. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
c. Review present and future needs of each contractor present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Work hours.

10) Hazards and risks.
11) Progress cleaning.
12) Quality and work standards.
13) Change Orders.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.8 SUBMITTALS

A. Contractor Deliverables:

B. Monthly Progress Report Deliverables: Prepare and submit Monthly Deliverables as described below:
1. Project Narrative providing executive summary, any schedule deviations, and current issues.
2. Update Schedule providing status of individual Activity Time and Cost Progress projected to end of month.
3. Safety Log providing to-date summary lists of incidents or illnesses.
4. Submittal Log.
5. RFI Log.
6. Change Order Log.
7. Quality Assurance/Quality Control Log, with summary statement.

C. Coordination Drawings: Prepare Coordination Drawings.

1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:

a. Indicate functional and spatial relationships of components of Civil, mechanical, and electrical systems.
b. Indicate required installation sequences.
c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Engineer for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

2. Sheet Size: At least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 40 inches (750 by 1000 mm).
3. Number of Copies: Submit two opaque copies of each submittal. Engineer will return one copy.

a. Submit five copies where Coordination Drawings are required for operation and maintenance manuals. Engineer will retain two copies; remainder will be returned.

4. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

D. Key Personnel Names: Within 15 days of receiving Notice To Proceed, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.9 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

1. Include special personnel required for coordination of operations with other contractors.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION
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3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

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SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

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. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Baseline Construction Schedule.
2. Update Construction Schedule.
3. Submittals Schedule.
4. Daily construction reports.
5. Material location reports.
6. Field condition reports.
7. Special reports.

B. Related Sections include the following:

1. Division 01 Section 01 29 00 "Payment Procedures" for submitting the Schedule of Values.
2. Division 01 Section 01 31 00 "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
3. Division 01 Section 01 33 00 "Submittal Procedures" for submitting schedules and reports.
4. Division 01 Section 01 40 00 "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the Schedule of Values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by Engineer.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Days: Unit of time duration in calendar days, unless specifically indicated to be work days.

F. Event: The starting or ending point of an activity.

G. Float: The measure of leeway in starting and completing an activity.

1. Float time belongs to Owner.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

H. Fragment: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

I. Major Area: A story of construction, a separate building, or a similar significant construction element.

J. Milestone: A key or critical point in time for reference or measurement.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. PDF electronic file.

B. Start-up construction schedule.

1. Approval of cost-loaded start-up construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource

loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.

E. Field Condition Reports: Submit at time of discovery of differing conditions.

F. Special Reports: Submit at time of unusual event.

G. Qualification Data: For scheduling consultant.

1.5 SUBMITTALS

A. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.
2. Specification Section number and title.
3. Submittal category (action or informational).
4. Name of subcontractor.
5. Description of the Work covered.
6. Scheduled date for Engineer's final release or approval.

B. Baseline Construction Schedule: Submit two opaque copies.

1. Approval of cost-loaded Baseline Construction Schedule will not constitute approval of Schedule of Values for cost-loaded activities.

C. Update Construction Schedule: Submit two opaque copies of Update Construction Schedule, large enough to show entire schedule for entire construction period.

1. Submit an electronic copy of schedule, using software indicated, on CD-R, and labeled to comply with requirements for submittals. Include type of schedule (Initial or Updated) and date on label.

D. Daily Construction Reports: Submit two copies at monthly intervals.

E. Material Location Reports: Submit two copies at monthly intervals.

F. Field Condition Reports: Submit two copies at time of discovery of differing conditions.

1.6 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Engineer's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Review delivery dates for Owner-furnished products.
4. Review schedule for work of Owner's separate contracts.
5. Review time required for review of submittals and resubmittals.
6. Review requirements for tests and inspections by independent testing and inspecting agencies.
7. Review time required for completion and startup procedures.
8. Review and finalize list of construction activities to be included in schedule.
9. Review submittal requirements and procedures.
10. Review procedures for updating schedule.

1.7 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Baseline and Update Construction Schedules with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from parties involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.

1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Baseline and Update Construction Schedule.
2. Initial Submittal: Submit concurrently with preliminary bar-chart schedule. Include submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

    a. At Contractor's option, show submittals on the Baseline Construction Schedule, instead of tabulating them separately.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Baseline Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."

B. Contractor's Construction Schedule Acceptance is represented in two forms: 1) Accepted Baseline Schedule, and 2) Accepted Monthly Update Schedule.

C. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

D. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 30 days, unless specifically allowed by Engineer.
2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 30 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

    a. Chiller Refurbishment
    b. Electrical Gear
    c. ATC Controls
    d. Cooling Tower Refurbishment
    e. Condenser Water Pump

3. Submittal Review Time: Include review and re-submittal times indicated in Division 01 Section 01 33 00 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
4. Startup and Testing Time: Include not less than 14 days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.
6. Punch List and Final Completion: Include not more than 30 days for punch list and final completion.

E. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work under More Than One Contract: Include a separate activity for each contract.
3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.

4. Work Restrictions: Show the effect of the following items on the schedule:

    a. Coordination with existing construction.
    b. Limitations of continued occupancies.
    c. Uninterruptible services.
    d. Partial occupancy before Substantial Completion.
    e. Use of premises restrictions.
    f. Provisions for future construction.
    g. Seasonal variations.
    h. Environmental control.

5. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

    a. Subcontract awards.
    b. Submittals.
    c. Purchases.
    d. Mockups.
    e. Fabrication.
    f. Sample testing.
    g. Deliveries.
    h. Installation.
    i. Tests and inspections.
    j. Adjusting.
    k. Curing.
    l. Startup and placement into final use and operation.

6. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

    a. Refurbishment Completion.
    b. Permanent space enclosure.
    c. Completion of mechanical installation.
    d. Completion of ductwork.
    e. Completion of electrical installation.
    f. Completion of testing/balancing.
    g. Substantial Completion.

F. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Equipment Deliveries Complete, Equipment in Place, Systems Ready for Test, Substantial Completion, and Final Completion

G. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragments to demonstrate the effect of the proposed change on the overall project schedule.

H. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.

1. Refer to Division 01 Section 01 29 00 "Payment Procedures" for cost reporting and payment procedures.

I. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered RFIs.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.

J. Recovery Schedule: When periodic update indicates the Work is fourteen (14) or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

K. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

1. Utilize Microsoft Project, Primavera, or Prolog, for Windows XP operating system.

2.3 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (refer to special reports).
10. Stoppages, delays, shortages, and losses.
11. Emergency procedures.
12. Orders and requests of authorities having jurisdiction.
13. Change Orders received and implemented.
14. Construction Change Directives received and implemented.
15. Services connected and disconnected.
16. Equipment or system tests and startups.
17. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.

C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation on CSI Form 13.2A. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Engineer, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES
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SECTION 01 33 00
SUBMITTAL PROCEDURES

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. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Sections include the following:

1. Division 01 Section 01 29 00 "Payment Procedures" for submitting Applications for Payment and the Schedule of Values.
2. Division 01 Section 01 31 00 "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
3. Division 01 Section 01 32 00 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
4. Division 01 Section 01 77 00 "Closeout Procedures" for submitting warranties.
5. Division 01 Section 01 78 39 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
6. Division 01 Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
7. Division 01 Section 01 79 00 "Demonstration and Training" for training of Owner's personnel.
8. Divisions 02 through 26 Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Engineer's responsive action.

B. Informational Submittals: Written information that does not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 SUBMITTAL PROCEDURES

A. General: Electronic copies of CAD Drawings of the Contract Drawings will be provided by Engineer for Contractor's use in preparing submittals at the cost identified in Paragraph 1.5.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Submittals Schedule: Comply with requirements in Division 01 Section 01 32 00 "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.
4. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Engineer and to Engineer's consultants, allow 15 days for review of each submittal. Submittal will be returned to Engineer before being returned to Contractor.

E. Identification: Place a permanent label or title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Engineer.
3. Include the following information on label for processing and recording action taken:

    a. Project name.
    b. Date.

c. Name and address of Engineer.
d. Name and address of Contractor.
e. Name and address of subcontractor.
f. Name and address of supplier.
g. Name of manufacturer.
h. Submittal number or other unique identifier, including revision identifier.

1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06100.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06100.01.A).

i. Number and title of appropriate Specification Section.
j. Drawing number and detail references, as appropriate.
k. Location(s) where product is to be installed, as appropriate.
l. Other necessary identification.

F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.

G. Additional Copies: Unless additional copies are required for final submittal, and unless Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Engineer.
2. Additional copies submitted for maintenance manuals will be marked with action taken and will be returned.

H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Engineer will return submittals, without review, received from sources other than Contractor.

1. Transmittal Form: Use CSI Form 12.1A found in Section 00 62 11 “Submittal Transmittal Form”.
2. Transmittal Form: Provide locations on form for the following information:

a. Project name.
b. Date.
c. Destination (To:).
d. Source (From:).
e. Names of subcontractor, manufacturer, and supplier.
f. Category and type of submittal.
g. Submittal purpose and description.
h. Specification Section number and title.
i. Drawing number and detail references, as appropriate.
j. Transmittal number.
k. Submittal and transmittal distribution record.
l. Remarks.
m. Signature of transmitter.

3. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.

I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked “Approved" or "Approved as Noted."
4. For any submittal requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.

J. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

K. Use for Construction: Use only final submittals with mark indicating "Approved" taken by Engineer

1.5 CONTRACTOR'S USE OF ENGINEER'S CAD FILES

A. General: At Contractor's written request, copies of Engineer's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:

B. General: Electronic copies of CAD Drawings of the Contract Drawings may be provided by Engineer for Contractor's use in preparing submittals.

1. The Documents for this project were prepared using commercial software on computers.
2. Drawing files (in AutoCAD V2018) are available to the Contractor.
3. These digital files will only be released with original signature on the "Digital Information Electronic Release Agreement Form found in Section 00 62 90 “CAD File Release”.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

1. Submit electronic submittals via email as PDF electronic files.

a. Engineer will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer's written recommendations.
    b. Manufacturer's product specifications.
    c. Manufacturer's installation instructions.
    d. Standard color charts.
    e. Manufacturer's catalog cuts.
    f. Wiring diagrams showing factory-installed wiring.
    g. Printed performance curves.
    h. Operational range diagrams.
    i. Standard product operation and maintenance manuals.
    j. Compliance with specified referenced standards.
    k. Testing by recognized testing agency.
    l. Application of testing agency labels and seals.
    m. Notation of coordination requirements.

4. Submit Product Data before or concurrent with Samples.
5. Number of Copies: Submit one PDF electronic file. Engineer will return one electronic copy with comment page. Mark up and retain one returned copy as a Project Record Document.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Engineer's CAD Drawings are otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Dimensions.
    b. Identification of products.
    c. Fabrication and installation drawings.
    d. Roughing-in and setting diagrams.
    e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
    f. Shopwork manufacturing instructions.
    g. Templates and patterns.
    h. Schedules.
    i. Design calculations.
    j. Compliance with specified standards.
    k. Notation of coordination requirements.
    l. Notation of dimensions established by field measurement.
    m. Relationship to adjoining construction clearly indicated.
    n. Seal and signature of professional engineer if specified.
    o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 40 inches (750 by 1000 mm).
3. Number of Copies: Submit two opaque (bond) copies of each submittal. Engineer will return one copy.

4. Number of Copies: Submit three opaque copies of each submittal, unless copies are required for operation and maintenance manuals. Submit five copies where copies are required for operation and maintenance manuals. Engineer will retain two copies; remainder will be returned.

5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

D. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section 01 32 00 "Construction Progress Documentation" for Construction Manager's action.

E. Submittals Schedule: Comply with requirements specified in Division 01 Section 01 32 00 "Construction Progress Documentation."

F. Application for Payment: Comply with requirements specified in Division 01 Section 01 29 00 "Payment Procedures."

G. Schedule of Values: Comply with requirements specified in Division 01 Section 01 29 00 "Payment Procedures."

H. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.
4. Number of Copies: Submit three copies of subcontractor list, unless otherwise indicated. Engineer will return two copies.

    a. Mark up and retain one returned copy as a Project Record Document.

2.2 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.

1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Engineer will not return copies.
2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section 01 40 00 "Quality Requirements."

B. Coordination Drawings: Comply with requirements specified in Division 01 Section 01 31 00 "Project Management and Coordination."

C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section 01 32 00 "Construction Progress Documentation."

D. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section 01 40 00 "Quality Requirements."

E. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

F. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

G. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section 01 78 23 "Operation and Maintenance Data."

H. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

I. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.

4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

J. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

K. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Engineer.

1. Engineer will not review submittals that include MSDSs and will return the entire submittal for resubmittal.

L. Coordination Drawings: Comply with requirements specified in Division 01 Section 01 31 00 "Project Management and Coordination."

M. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of engineers, architects, and owners, and other information specified.

N. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

O. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

R. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

S. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

U. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section 01 40 00 "Quality Requirements."

V. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

W. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

X. Field Test Reports: Submit reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

Y. Maintenance Data: Comply with requirements specified in Division 01 Section 01 78 23 "Operation and Maintenance Data."

Z. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ENGINEER'S / ACTION

A. General: Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or modifications required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
   1. Reviewed: Approved.
   2. Reviewed: Submittals which require no corrections.
   3. Rejected: Not Approved. Constricting to requirement of the Contract Documents. Do not perform work illustrated.
   4. Resubmit as specified: Item required major correction, future clarification and/or completion. Do not perform work illustrated.
   5. For Information only/Not Reviewed: Submittals that are not required by Contract Documents to be reviewed by Engineer.
   6. Comments Noted: Make corrections noted.
   7. Revise & Resubmit: To be corrected and returned for approval. Do not perform work as illustrated.
   8. Resubmit for Record Only: Proceed with work and re-submit information submitted for Engineers records.

C. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.

D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION

SECTION 01 40 00
QUALITY REQUIREMENTS
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SECTION 01 40 00
QUALITY REQUIREMENTS

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 administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and -control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections:
1. Division 01 Section 01 32 00 "Construction Progress Documentation" for developing a schedule of required tests and inspections.
2. Divisions 02 through 28 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Engineer.

C. Preconstruction Testing: Tests and inspections performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

E. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade or trades.

I. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.5 ACTION SUBMITTALS

A. Shop Drawings: For ductwork, provide plans, sections, and elevations, indicating materials and size of mockup construction.

1. Indicate manufacturer and model number of individual components.
2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Contractor's Quality-Control Manager Qualifications: For supervisory personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems.

1. Seismic-force resisting system, designated seismic system, or component listed in the designated seismic system quality assurance plan prepared by the Engineer.
2. Main wind-force resisting system or a wind-resisting component listed in the wind-force-resisting system quality assurance plan prepared by the Engineer.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

1.7 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.

10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspection.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of technical representatives making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.8 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.

e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
f. When testing is complete, remove test specimens, assemblies, mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Engineer, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.9 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
3. Costs for retesting and reinspection construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section 01 33 00 "Submittal Procedures."

D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

E. Retesting/Reinspection: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspection, for construction that replaced Work that failed to comply with the Contract Documents.

F. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Owner, Engineer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Engineer.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Engineer's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section 01 73 00 "Execution Requirements."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS
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SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

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. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Sections include the following:

1. Division 01 Section 01 11 00 "Summary" for limitations on utility interruptions and other work restrictions.
2. Division 01 Section 01 33 00 "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
3. Division 01 Section 01 73 00 "Execution Requirements" for progress cleaning requirements.
4. Divisions 02 through 26 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.3 USE CHARGES

A. General: Utility usage shall not be metered. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Engineer, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Owner will pay sewer service use charges for sewer usage by all entities for construction operations.

C. Water Service: Owner will pay water service use charges for water used by all entities for construction operations.

D. Electric Power Service: Utility usage shall not be metered. Provide connections and extensions of services as required for construction operations.

E. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

F. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 SUBMITTALS

A. Site Plan: Show temporary facilities, staging areas, crane mobilization area, and parking areas for construction personnel.

B. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage, including delivery, handling, and storage provisions for materials subject to water absorption or water damage, discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water damaged Work.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

A. Field Offices, General: Space within building shall be utilized as field offices.

2.2 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.

2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance as specified in Division 01 Section 01 11 00 "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Water Service: Use of Owner's existing water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

1. Where installations below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.

C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities. Owner will not allow use of onsite sanitary facilities.

D. Electric Power Service: Use of Owner's existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to Owner.

E. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until Engineer schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

C. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

D. Project Identification and Temporary Signs: Provide Project identification and other signs. Install signs where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.

1. Provide temporary, directional signs for construction personnel and visitors.
2. Maintain and touchup signs so they are legible at all times.

E. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.

G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section 01 73 00 "Execution Requirements" for progress cleaning requirements.

H. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Division 01 Section 01 11 00 “Summary of Work."

B. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

C. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

1. Construct covered walkways using scaffold or shoring framing.
2. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
3. Paint and maintain appearance of walkway for duration of the Work.

D. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.

E. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section 01 77 00 "Closeout Procedures."

END OF SECTION

SECTION 01 60 00
PRODUCT REQUIREMENTS
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SECTION 01 60 00
PRODUCT REQUIREMENTS

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. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

B. Related Sections include the following:

1. Division 01 Section 01 77 00 "Closeout Procedures" for submitting warranties for Contract closeout.
2. Division 01 Section 01 23 00 "Alternates" for products selected under an alternate.
3. Division 01 Section 01 25 00 "Substitution Procedures" for requests for substitutions.
4. Divisions 02 through 26 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number, or first named product, or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

1.4 SUBMITTALS

A. Product List: Submit a list, in tabular from, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.

1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
2. Form: Tabulate information for each product under the following column headings:

    a. Specification Section number and title.
    b. Generic name used in the Contract Documents.
    c. Proprietary name, model number, and similar designations.
    d. Manufacturer's name and address.
    e. Supplier's name and address.
    f. Installer's name and address.
    g. Projected delivery date or time span of delivery period.
    h. Identification of items that require early submittal approval for scheduled delivery date.

3. Initial Submittal: Within 30 days after date of commencement of the Work, submit 3 copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.

    a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.

4. Completed List: Within 60 days after date of commencement of the Work, submit 3 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
5. Engineer's Action: Engineer will respond in writing to Contractor within 15 days of receipt of completed product list. Engineer's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Engineer's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.

B. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use CSI Form 13.1A found in Section 00 63 25.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified material or product cannot be provided.
b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers and owners.
g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
j. Cost information, including a proposal of change, if any, in the Contract Sum.
k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Engineer will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

a. Form of Acceptance: Change Order.
b. Use product specified if Engineer cannot make a decision on use of a proposed substitution within time allocated.

C. Comparable Product Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

a. Form of Approval: As specified in Division 01 Section 01 33 00 "Submittal Procedures."
b. Use product specified if Engineer cannot make a decision on use of a comparable product request within time allocated.

D. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section 01 33 00 “Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store cementitious products and materials on elevated platforms.
5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
3. Refer to Divisions 02 through 26 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section 01 77 00 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Engineer will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is Engineer's.

6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Engineer's sample. Engineer's decision will be final on whether a proposed product matches.

    a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.

10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.

    a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Engineer will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.

b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Engineer will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

A. Timing: Engineer will consider requests for substitution if received within 15 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Engineer.

B. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:

1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Engineer for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
2. Requested substitution does not require extensive revisions to the Contract Documents.
3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not adversely affect Contractor's Construction Schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.
10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

2.3 COMPARABLE PRODUCTS

A. Conditions: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers and owners, if requested.

5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 01 73 00
EXECUTION

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. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. General installation of products.
4. Coordination of Owner-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

B. Related Sections include the following:

1. Division 01 Section 01 31 00 "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
2. Division 01 Section 01 33 00 "Submittal Procedures" for submitting surveys.
3. Division 01 Section 01 73 29 "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
4. Division 01 Section 01 77 00 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

A. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate how long services and systems will be disrupted.

B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Engineer of locations and details of cutting and await directions from the Engineer before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:

a. Primary operational systems and equipment.
b. Fire separation assemblies.
c. Air or smoke barriers.
d. Fire-suppression systems.
e. Mechanical systems piping and ducts.
f. Control systems.
g. Communication systems.
h. Conveying systems.
i. Electrical wiring systems.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

    a. Water, moisture, or vapor barriers.
    b. Membranes and flashings.
    c. Equipment supports.
    d. Piping, ductwork, vessels, and equipment.
    e. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to the Engineer for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.

B. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

a. Description of the Work.
b. List of detrimental conditions, including substrates.
c. List of unacceptable installation tolerances.
d. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer. Include a detailed description of problem encountered, together with recommendations for changing the

Contract Documents. Submit requests on CSI Form 13.2A, "Request for Interpretation", form enclosed in Division 01 Section 01 32 00 "Construction Progress Documentation."

D. Surface and Substrate Preparation: Comply with manufacturer's recommendations for preparation of substrates to receive subsequent work.

3.3 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.
2. Allow for piping, building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. 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.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.4 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Temporary Support: Provide temporary support of work to be cut.

C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

D. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
5. Proceed with patching after construction operations requiring cutting are complete.

E. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

F. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.5 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.6 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

F. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

G. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

H. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

I. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section 01 40 00 "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section 01 73 29 "Cutting and Patching."

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

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SECTION 01 73 29
CUTTING AND PATCHING

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. This Section includes procedural requirements for cutting and patching.

B. Related Sections include the following:

1. Division 01 Section 01 73 20 "Selective Demolition" for demolition of selected portions.
2. Divisions 02 through 28 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
3. Division 07 Section 07 84 13 "Penetration Firestopping" for patching fire-rated construction.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
3. Products: List products to be used and firms or entities that will perform the Work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.

6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
7. Engineer's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operating elements include the following:

1. Primary operational systems and equipment.
2. Air or smoke barriers.
3. Fire-suppression systems.
4. Mechanical systems piping and ducts.
5. Control systems.
6. Communication systems.
7. Electrical wiring systems.

C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Miscellaneous elements include the following:

1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Exterior curtain-wall construction.
4. Equipment supports.
5. Piping, ductwork, vessels, and equipment.
6. Noise- and vibration-control elements and systems.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
5. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance.

    a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance. Where ceiling tiles are removed and are damaged, the

same shall be replaced with new ceiling tiles to match existing. Where ceiling grid is damaged replace with new ceiling grid to match existing.

5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
6. Patch and repair masonry work to match exiting adjacent construction.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION

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SECTION 01 77 00
CLOSE-OUT PROCEDURES
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SECTION 01 77 00
CLOSEOUT PROCEDURES

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. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Inspection procedures.
2. Substantial Completion procedures.
3. Final completion procedures.
4. Warranties.
5. Final cleaning.

B. Related Sections include the following:

1. Division 01 Section 01 29 00 "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
2. Division 01 Section 01 73 00 "Execution" for progress cleaning of Project site.
3. Division 01 Section 01 78 39 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
4. Division 01 Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.
5. Division 01 Section 01 79 00 "Demonstration and Training" for requirements for instructing Owner's personnel.
6. Divisions 02 through 26 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Prepare and submit Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
8. Complete startup testing of systems.
9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 01 Section 01 29 00 "Payment Procedures."
2. Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report and warranty.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training videotapes.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements.

Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Engineer.
    d. Name of Contractor.
    e. Page number.

1.6 WARRANTIES

A. Submittal Time: Submit written warranties on request of Engineer for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
4. Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide table of contents at beginning of document.

C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers for final cleaning. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent.

l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

1) Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates.

m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

n. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

p. Clean ducts, chiller, and cooling tower if units were operated without filters during construction or that display contamination with particulate matter upon inspection.

q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

r. Leave Project clean and ready for occupancy.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

D. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section 01 50 00 "Temporary Facilities and Controls."

END OF SECTION

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SECTION 01 78 23
OPERATION AND MAINTENANCE DATA
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PART 3 EXECUTION

3.1 MANUAL PREPARATION

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SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

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. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Maintenance manuals for the care and maintenance of systems and equipment.

B. Related Sections include the following:
1. Division 01 Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Division 01 Section 01 77 00 "Closeout Procedures" for submitting operation and maintenance manuals.
3. Division 01 Section 01 78 39 "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
4. Divisions 02 through 26 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 SUBMITTALS

A. Initial Submittal: Submit 2 draft copies of each manual at least 15 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Engineer will return both copy of draft and mark whether general scope and content of manual are acceptable.

B. Final Submittal: Submit one copy of each manual in final form at least 15 days before final inspection. Engineer will return copy with comments within 15 days after final inspection.

1. Correct or modify each manual to comply with Engineer's comments. Submit three (3) copies of each corrected manual within 15 days of receipt of Engineer's comments and one (1) copy electronically.

1.5 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:

1. List of documents.
2. List of equipment.
3. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:

1. Subject matter included in manual.

2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name, address, and telephone number of Contractor.
6. Name and address of Engineer.
7. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

    a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
    b. Identify each binder on front and spine, with printed title “Delcastle High School Chiller/Cooling Tower Refurbishment OPERATION AND MAINTENANCE MANUAL" and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

    a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

2.4 PRODUCT MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.

2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.

1. Do not use original Project Record Documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared Record Drawings in Division 01 Section 01 78 39 "Project Record Documents."

G. Comply with Division 01 Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION

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3.1 RECORDING AND MAINTENANCE

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SECTION 01 78 39
PROJECT RECORD DOCUMENTS

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. This Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.

B. Related Sections include the following:

1. Division 01 Section 01 73 00 "Execution Requirements" for final property survey.
2. Division 01 Section 01 77 00 "Closeout Procedures" for general closeout procedures.
3. Division 01 Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.
4. Divisions 02 through 28 Sections for specific requirements for project record documents of the Work in those Sections

1.3 SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up Record Prints.

B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one copy of each Product Data submittal.

1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.

1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Accurately record information in an understandable drawing technique.
c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Revisions to routing of piping and conduits.
d. Revisions to electrical circuitry.
e. Actual equipment locations.
f. Locations of concealed internal utilities.
g. Changes made by Change Order or Construction Change Directive.
h. Changes made following Engineer's written orders.
i. Details not on the original Contract Drawings.
j. Field records for variable and concealed conditions.
k. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Transparencies: Immediately before inspection for Certificate of Substantial Completion, review marked-up Record Prints with Engineer. When authorized, prepare a full set of corrected transparencies of the Contract Drawings and Shop Drawings.

1. Incorporate changes and additional information previously marked on Record Prints. Erase, redraw, and add details and notations where applicable.
2. Refer instances of uncertainty to Engineer for resolution.

3. Owner will furnish Contractor one set of transparencies of the Contract Drawings for use in recording information.
4. Print the Contract Drawings and Shop Drawings for use as Record Transparencies. Engineer will make the Contract Drawings available to Contractor's print shop.

C. Format: Identify and date each Record Drawing; include the designation “Delcastle Chiller/Cooling Tower Refurbishment PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Record Transparencies: Organize into unbound sets matching Record Prints. Place transparencies in durable tube-type drawing containers with end caps. Mark end cap of each container with identification. If container does not include a complete set, identify Drawings included.
3. Identification: As follows:

   a. Project name.
   b. Date.
   c. Designation “Delcastle Chiller/Cooling Tower Refurbishment PROJECT RECORD DRAWINGS."
   d. Name of Engineer.
   e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Engineer's reference during normal working hours.

END OF SECTION

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DEMONSTRATION AND TRAINING
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PART 3 EXECUTION

3.1 PREPARATION
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SECTION 01 79 00
DEMONSTRATION AND TRAINING

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. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration and training video recordings.

B. Related Sections include the following:

1. Division 01 Section 01 31 00 "Project Management and Coordination" for requirements for preinstruction conferences.
2. Divisions 02 through 26 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 SUBMITTALS

A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. At completion of training, submit one complete training manual(s) for Owner's use.

B. Qualification Data: For instructor.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

   a. Name of Project.
   b. Name of Engineer.
   c. Name of Contractor.
   d. Date of video recording.

2. Transcript: Prepared on 8-1/2-by-11-inch (215-by-280-mm) paper, punched and bound in heavy-duty, three-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
3. At completion of training, submit complete training manual(s) for Owner's use.

1.5 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Engineer.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:

1. Electrical components
2. Chiller and Chilled Water System
3. ATC System
4. Cooling Tower/Condenser Water
5. Condenser Water Pump
6. Refrigerant Monitoring System
7. SCBA

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

   a. System, subsystem, and equipment descriptions.
   b. Performance and design criteria if Contractor is delegated design responsibility.
   c. Operating standards.
   d. Regulatory requirements.
   e. Equipment function.
   f. Operating characteristics.
   g. Limiting conditions.
   h. Performance curves.

2. Documentation: Review the following items in detail:
   a. Operations manuals.
   b. Maintenance manuals.
   c. Project Record Documents.
   d. Identification systems.
   e. Warranties and bonds.
   f. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.

f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for emergencies.
   j. Operating procedures for system, subsystem, or equipment failure.
   k. Seasonal and weekend operating instructions.
   l. Required sequences for electric or electronic systems.
   m. Special operating instructions and procedures.

5. Adjustments: Include the following:

   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

   a. Diagnostic instructions.
   b. Test and inspection procedures.

7. Maintenance: Include the following:

   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.

8. Repairs: Include the following:

   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual organized in coordination with requirements in Division 01 Section 01 78 23 "Operations and Maintenance Data."

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Engineer will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
2. Owner will furnish an instructor to describe Owner's operational philosophy.
3. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner, through Engineer, with at least seven days' advance notice.

D. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION

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GENERAL COMMISSIONING REQUIREMENTS
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SECTION 01 91 13
GENERAL COMMISSIONING REQUIREMENTS

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. This Section includes general requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.

B. Related Sections include the following:

1. Division 23 Section 23 08 00 "Commissioning of HVAC" for specific requirements for commissioning HVAC systems.

2. Division 01 Section 01 77 00 "Close-Out Procedures" for specific requirements for closeout at substantial and final completion.

3. Division 01 Section 01 77 00 "Close-Out Procedures" for Specific Requirements for training and demonstration of systems to Owner.

4. Division 01 Section 01 77 00 "Close-Out Procedures" for Specific Requirements related to the Preparation of systems operation and maintenance manuals.

1.3. DEFINITIONS

A. CxA: Commissioning Authority.

B. OPR: Owner's Project Requirements.

C. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

D. TAB: Testing, Adjusting, and Balancing.

1.4. COMMISSIONING TEAM

A. Members Appointed by Contractor(s): Individuals, each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:

1. CxA: The designated person, company, or entity that plans, schedules, and

coordinates the commissioning team to implement the commissioning process. The CxA for this project shall be performed by Gipe Associates, Inc., 8719 Brooks Drive, Easton, Maryland 21601, (410) 822-8688 - telephone, (410) 822-6306 – fax.

2. All contractor commissioning requirements and costs associated with commissioning the project shall be included in the base bid.

3. Representatives of the facility user and operation and maintenance personnel.

4. Engineering design professionals.

1.5. OWNER'S RESPONSIBILITIES

A. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to, the following:

1. Coordination meetings.

2. Training in operation and maintenance of systems, subsystems, and equipment.

3. Testing meetings.

4. Demonstration of operation of systems, subsystems, and equipment.

1.6. CONTRACTOR'S RESPONSIBILITIES

A. Provide utility services required for the commissioning process.

B. Contractor shall assign representatives with expertise and authority to act on behalf of the Contractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:

1. Participate in commissioning and construction-phase coordination meetings.

2. Participate in maintenance orientation and inspection.

3. Participate in operation and maintenance training sessions.

4. Participate in final review at acceptance meeting.

5. Certify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.

6. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.

7. Review and approve final commissioning documentation.

8. Certify that all pre-test work and pre-testing of functional performance tests are complete and operational prior to scheduling performed testing by CxA. Submit

completed functional performance test forms with data from pre-testing.

9. During functional performance testing, a representative from the mechanical contractor, controls contractor, and test/balance engineer must be present and participate in testing.

C. Subcontractors shall assign representatives with expertise and authority to act on behalf of subcontractors and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:

1. Pre-test all systems/equipment prior to engaging CxA for Functional Performance Testing.

2. Participate in commissioning and construction-phase coordination meetings.

3. Participate in maintenance orientation and inspection.

4. Participate in procedures meeting for testing.

5. Participate in final review at acceptance meeting.

6. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to CxA for incorporation into the commissioning plan. Update schedule on a weekly basis throughout the construction period.

7. Provide information to the CxA for developing construction-phase commissioning plan.

8. Participate in training sessions for Owner's operation and maintenance personnel.

9. Provide updated Project Record Documents to the CxA on a daily basis.

10. Gather and submit operation and maintenance data for systems, subsystems, and equipment to the CxA, as specified in Division 01 Section 01 78 23 "Operation and Maintenance Data."

11. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures and participate in testing of installed systems, subsystems, and equipment.

12. The test/balance subcontractor, mechanical contractor, and automatic temperature controls subcontractor must be on-site and provide assistance during all functional performance testing.

1.7. CXA'S RESPONSIBILITIES

A. Organize and lead the commissioning team.

B. Prepare a construction-phase commissioning plan. Collaborate with Contractor and with subcontractors to develop test and inspection procedures. Include design changes and scheduled commissioning activities coordinated with overall Project schedule. Identify commissioning team member responsibilities, by name, firm, and trade specialty, for

performance of each commissioning task.

C. Convene commissioning team meetings for the purpose of coordination, communication, and conflict resolution; discuss progress of the commissioning processes. Responsibilities include arranging for facilities, preparing agenda and attendance lists, and notifying participants. The CxA shall prepare and distribute minutes to commissioning team members and attendees within five workdays of the commissioning meeting.

D. At a mutually agreed upon time, conduct an initial construction-phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; TAB Work; and Project completion.

E. Observe and inspect construction and report progress and deficiencies. In addition to compliance with the Contract Documents, inspect systems and equipment installation for adequate accessibility for maintenance and component replacement or repair.

F. Prepare Project-specific test and inspection procedures and checklists.

G. Schedule, direct, witness, and document tests, inspections, and systems startup.

H. Compile test data, inspection reports, and certificates and include them in the systems manual and commissioning report.

I. Certify date of acceptance and startup for each item of equipment for start of warranty periods.

J. Review Project Record Documents for accuracy. Request revisions from Contractor to achieve accuracy. Project Record Documents requirements are specified in Division 01 Section 01 78 39 "Project Record Documents."

K. Review and comment on operation and maintenance documentation and systems manual outline for compliance with the Contract Documents. Operation and maintenance documentation requirements are specified in Division 01 Section 01 78 23 "Operation and Maintenance Data."

L. Assemble the final commissioning documentation, including the commissioning report and Project Record Documents.

1.8. COMMISSIONING DOCUMENTATION

A. Commissioning Plan: A document, prepared by CxA, that outlines the schedule, allocation of resources, and documentation requirements of the commissioning process, and shall include, but is not limited to the following:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports. Identification of the relationship of these documents to other functions and a detailed description of submittals that are required to support the commissioning processes. Submittal dates shall include the latest date approved submittals must be received without adversely affecting commissioning plan.

2. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.

3. Identification of systems and equipment to be commissioned.

4. Description of schedules for testing procedures along with identification of parties involved in performing and verifying tests.

5. Identification of items that must be completed before the next operation can proceed.

6. Description of responsibilities of commissioning team members.

7. Description of observations to be made.

8. Description of requirements for operation and maintenance training, including required training materials.

9. Description of expected performance for systems, subsystems, equipment, and controls.

10. Schedule for commissioning activities with specific dates coordinated with overall construction schedule.

11. Identification of installed systems, subsystems, and equipment, including design changes that occurred during the construction phase.

12. Process and schedule for documenting changes on a continuous basis to appear in Project Record Documents.

13. Process and schedule for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.

14. Step-by-step procedures for testing systems, subsystems, and equipment with descriptions for methods of verifying relevant data, recording the results obtained, and listing parties involved in performing and verifying tests.

B. Test Checklists: CxA, with assistance of Contractor and Subcontractors, shall develop test checklists for each system, subsystem, or equipment including interfaces and interlocks, and include a separate entry, with space for comments, for each item to be tested. Prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. Provide space for testing personnel to sign off on each checklist. Specific checklist content requirements are specified in Division 23 Section 23 08 00 "HVAC Commissioning Requirements". Test checklists will be jointly developed as the project progresses. Each checklist, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:

1. Name and identification code of tested item.

2. Test number.

3. Time and date of test.

4. Indication of whether the record is for a first test or retest following correction of a problem or issue.

5. Dated signatures of the person performing test and of the witness, if applicable.

6. Individuals present for test.

7. Deficiencies.

8. Issue number, if any, generated as the result of test.

C. Certificate of Readiness: Certificate of Readiness shall be signed by Contractor, Subcontractor(s), Installer(s), and CxA certifying that systems, subsystems, equipment, and associated controls are ready for testing. Completed test checklists signed by the responsible parties shall accompany this certificate.

D. Test and Inspection Reports: CxA shall record test data, observations, and measurements on test checklists. Photographs, forms, and other means appropriate for the application shall be included with data. CxA shall compile test and inspection reports and test and inspection certificates and include them in systems manual and commissioning report.

E. Corrective Action Documents: CxA shall document corrective action taken for systems and equipment that fail tests. Include required modifications to systems and equipment and revisions to test procedures, if any. Retest systems and equipment requiring corrective action and document retest results.

F. Issues Log: CxA shall prepare and maintain an issues log that describes design, installation, and performance issues that are at variance with the Contract Documents. Identify and track issues as they are encountered, documenting the status of unresolved and resolved issues.

1. Creating an Issues Log Entry:

   a. Identify the issue with unique numeric or alphanumeric identifier by which the issue may be tracked.
   b. Assign a descriptive title of the issue.
   c. Identify date and time of the issue.
   d. Identify test number of test being performed at the time of the observation, if applicable, for cross-reference.
   e. Identify system, subsystem, and equipment to which the issue applies.
   f. Identify location of system, subsystem, and equipment.
   g. Include information that may be helpful in diagnosing or evaluating the issue.
   h. Note recommended corrective action.
   i. Identify commissioning team member responsible for corrective action.
   j. Identify expected date of correction.
   k. Identify person documenting the issue.

2. Documenting Issue Resolution:

a. Log date correction is completed or the issue is resolved.
b. Describe corrective action or resolution taken. Include description of diagnostic steps taken to determine root cause of the issue, if any.
c. Identify changes to the Contract Documents that may require action.
d. State that correction was completed and system, subsystem, and equipment is ready for retest, if applicable.
e. Identify person(s) who corrected or resolved the issue.
f. Identify person(s) documenting the issue resolution.

3. Issues Log Report: On a periodic basis, but not less than for each commissioning team meeting, CxA shall prepare a written narrative for review of outstanding issues and a status update of the issues log. As a minimum, CxA shall include the following information in the issues log and expand it in the narrative:

a. Issue number and title.
b. Date of the identification of the issue.
c. Name of the commissioning team member assigned responsibility for resolution.
d. Expected date of correction.

G. Commissioning Report: CxA shall document results of the commissioning process including unresolved issues and performance of systems, subsystems, and equipment. The commissioning report shall indicate whether systems, subsystems, and equipment have been completed and are performing according to the Contract Documents. The commissioning report shall include, but is not limited to, the following:

1. Lists and explanations of substitutions; compromises; variances in the Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. This report shall be used to evaluate systems, subsystems, and equipment and shall serve as a future reference document during Owner occupancy and operation. It shall describe components and performance that exceed requirements of the Contract Documents and those that do not meet requirements of the Contract Documents. It may also include a recommendation for accepting or rejecting systems, subsystems, and equipment.

2. Commissioning plan.

3. Testing plans and reports.

4. Corrective modification documentation.

5. Issues log.

6. Completed test checklists.

7. Listing of off-season test(s) not performed and a schedule for their completion.

8. All commissioning documents must be submitted to the building Owner within 90 days of the date of receipt of the Certificate of Occupancy.

H. Systems Manual: CxA shall gather required information and compile systems manual.

Systems manual shall include, but is not limited to, the following:

1. Project Record Documents as specified in Division 01 Section 01 78 39 "Project Record Documents."

2. Final commissioning plan.

3. Commissioning report.

4. Operation and maintenance data as specified in Division 01 Section 01 78 23 "Operation and Maintenance Data."

1.9. SUBMITTALS

A. Test Checklists and Report Forms: CxA shall submit sample checklists and forms to Contractor quality-control manager and subcontractors for review and comment. Submit two copies of each checklist and report form.

B. Test and Inspection Reports: CxA shall submit test and inspection reports.

C. Corrective Action Documents: CxA shall submit corrective action documents.

1.10. QUALITY ASSURANCE

A. Instructor Qualifications: Factory-authorized service representatives, experienced in training, operation, and maintenance procedures for installed systems, subsystems, and equipment.

B. Test Equipment Calibration: Comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping. Affix calibration tags to test instruments. Instruments shall have been calibrated within six months prior to use.

1.11. COORDINATION

A. Coordinating Meetings: CxA shall conduct coordination meetings of the commissioning team to review progress on the commissioning plan, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities.

B. Pretesting Meetings: CxA shall conduct pretest meetings of the commissioning team to review startup reports, pretest inspection results, testing procedures, testing personnel and instrumentation requirements, and manufacturers' authorized service representative services for each system, subsystem, equipment, and component to be tested.

C. Testing Coordination: CxA shall coordinate sequence of testing activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

D. Manufacturers' Field Services: CxA and Contractor shall coordinate services of manufacturers' field services.

PART 2. PRODUCTS (NOT USED)

PART 3. EXECUTION

3.1. OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

A. Training Preparation Conference: Before operation and maintenance training, CxA shall convene a training preparation conference to include Owner's operation and maintenance personnel, Contractor, and subcontractors. In addition to requirements specified in Division 01 Section 01 79 00 "Demonstration and Training," perform the following:

1. Review installed systems, subsystems, and equipment.

2. Review instructor qualifications.

3. Review instructional methods and procedures.

4. Review training module outlines and contents.

5. Review course materials (including operation and maintenance manuals).

6. Inspect and discuss locations and other facilities required for instruction.

7. Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.

8. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

B. Training Modules: Develop an instruction program that includes individual training modules for each system, subsystem, and equipment as specified in Division 01 Section 01 79 00 "Demonstration and Training."

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SELECTIVE DEMOLITION
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SECTION 02 41 19
SELECTIVE DEMOLITION

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. This Section includes the following:

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 Sections include the following:

1. Division 01 Section 01 11 00 "Summary of Work" for use of premises and Owner-occupancy requirements.
2. Division 01 Section 01 50 00 "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
3. Division 01 Section 01 73 29 "Cutting and Patching" for cutting and patching procedures.

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: Detach items from existing construction and deliver them to Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

A. Items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove each item or object in a manner to prevent damage and deliver promptly to Owner.

1.5 SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. 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. Ensure Owner's building manager's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Locations of proposed dust- and noise-control temporary partitions and means of egress.
6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
7. Means of protection for items to remain and items in path of waste removal from building.

C. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

D. Predemolition Videotapes: Show existing conditions of adjoining construction, including finish surfaces that might be misconstrued as damage caused by selective demolition operations.

E. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.6 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Standards: Comply with ANSI A10.6 and NFPA 241.

D. Refrigerant Recovery Technician Qualifications: Certified by an EPA – approved certification program.

E. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 01 Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:

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.

1.7 PROJECT CONDITIONS

A. Owner will occupy portions of building and site immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

1. Comply with requirements specified in Division 01 Section 01 11 00 "Summary of Work."

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition. Video tape all existing areas prior to selective demolition work.

D. 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 materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Engineer and Owner. Owner will remove hazardous materials under a separate contract.

E. Hazardous Materials: Hazardous materials are present in construction to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Hazardous material remediation is specified elsewhere in the Contract Documents.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.

F. Storage or sale of removed items or materials on-site is not permitted.

G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain existing site fire-protection facilities in service during selective demolition operations.

1.8 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

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 Engineer.

E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

F. Survey of Existing Conditions: Record existing conditions by use of measured drawings and preconstruction digital videotapes.
   1. 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: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

   1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section 01 11 00 "Summary of Work."

B. Service/System Requirements: 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, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
   4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

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 Division 01 Section 01 50 00 "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 Division 01 Section 01 50 00 "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.

B. 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 on-campus.
5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
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.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, 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.

E. Air-Conditioning Equipment: Refurbish equipment without releasing refrigerants.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be 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.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 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.

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SECTION 07 84 13
PENETRATION FIRESTOPPING

PART 1. GENERAL

1.1. SUMMARY

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section includes:

1. Through-penetration firestopping in fire rated construction.

2. Through-penetration smoke-stopping in smoke partitions.

1.2. REFERENCES

A. Underwriters Laboratories

1. UL Fire Resistance Directory

a. Through-penetration firestop devices (XHCR)
b. Fire resistance rating (BXUV)
c. Through-penetration firestop systems (XHEZ)
d. Fill, void, or cavity material (XHHW)

B. American Society for Testing and Materials Standards:

C. ASTM E 814-88: Standard Test Method for Fire Tests of Through-Penetration Firestops.

1.3. DEFINITIONS

A. Assembly: Particular arrangement of materials specific to given type of construction described or detailed in referenced documents.

B. Barriers: Time-rated fire walls, smoke barrier walls, time-rated ceiling/floor assemblies and structural floors.

C. Firestopping: Methods and materials applied in penetrations and unprotected openings to limit spread of heat, fire, gasses and smoke.

D. Penetration: Opening or foreign material passing through or into barrier or structural floor such that full thickness of rated materials is not obtained.

E. System: Specific products and applications, classified and numbered by Underwriters Laboratories, Inc. to close specific barrier penetrations.

F. Sleeve: Metal fabrication or pipe section extended through thickness of barrier and used to permanently guard penetration. Sleeves are described as part of penetrating system in

other sections and may or may not be required.

1.4. SYSTEM DESCRIPTION

A. Design Requirements

1. Fire-rated construction: Maintain barrier and structural floor fire resistance ratings including resistance to cold smoke at all penetrations.

2. Smoke barrier construction: Maintain barrier and structural floor resistance to cold smoke at all penetrations.

1.5. SUBMITTALS

A. Submit in accordance with Division 01 Section 01 33 00 “Submittal Procedures”, unless otherwise indicated.

B. Product data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication.

2. Manufacturer's installation instructions.

C. Shop drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements.

1. Details of each proposed assembly identifying intended products and applicable UL system number, or UL classified devices.

2. Manufacturer or manufacturer's representative shall provide qualified engineering judgment and drawings relating to non-standard applications as needed.

D. Quality control submittals:

1. Statement of qualifications.

E. Applicators' qualifications statement:

1. List past projects indicating required experience.

1.6. QUALITY ASSURANCE

A. Installer's qualifications: Fire experienced in installation or application of systems similar in complexity to those required for this project, plus the following:

1. Acceptable to or licensed by manufacturer, State or local authority where applicable.

2. At least 2 years experience with systems.

3. Successfully completed at least 5 comparable scale projects using this system.

B. Local and State regulatory requirements: Submit forms or acceptance for proposed assemblies not conforming to specific UL Firestop System numbers, or UL classified devices.

C. Materials shall have been tested to provide fire rating at least equal to that of the construction.

1.7. DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:

1. Deliver products in original unopened packaging with legible manufacturer's identification.

2. Coordinate delivery with scheduled installation date, allow minimum storage at site.

B. Storage and protection: Store materials in a clean, dry, ventilated location. Protect from soiling, abuse, moisture and freezing when required. Follow manufacturer's instructions.

1.8. PROJECT CONDITIONS

A. Existing condition:

1. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

2. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

B. Environmental requirements:

1. Furnish adequate ventilation if using solvent.

2. Furnish forced air ventilation during installation if required by manufacturer.

3. Keep flammable materials away from sparks or flame.

4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.

1.9. WARRANTY

A. Submit copies of written warranty agreeing to repair or replace joint sealers which fail in joint adhesion, extrusion resistance, migration resistance, or general durability or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated. The warranty period shall be two (2) years from date of substantial completion unless otherwise noted.

PART 2. PRODUCTS

2.1. THROUGH-PENETRATION FIRESTOPPING OF FIRE-RATED CONSTRUCTION

A. Systems of devices listed in the UL Fire Resistance Directory under categories XHCR and XHEZ may be used, providing that it conforms to the construction type, penetrant type, annular space requirements and fire rating involved in each separate instance, and that the system be symmetrical for wall applications. Systems or devices must be asbestos-free.

1. Additional requirements: Withstand the passage of cold smoke either as an inherent property of the system, or by the use of a separate product included as a part of the UL system or device, and designed to perform this function.

2. Acceptable manufacturers and products.

a. Those listed in the UL Fire Resistance directory for the UL System involved and as further defined in the System and Applications Schedule in Part 3.6 of this section.

3. All firestopping products must be from a single manufacturer. All trades shall use products from the same manufacturer unless otherwise noted.

2.2. ACCESSORIES

A. Fill, void or cavity materials: As classified under category XHHW in the UL Fire Resistance Directory.

B. Forming materials: As classified under category XHKU in the UL Fire Resistance Directory.

PART 3. EXECUTION

3.1. EXAMINATION

A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

1. Verify barrier penetrations are properly sized and in suitable condition for application of materials.

2. Do not proceed until unsatisfactory conditions have been corrected.

B. Coordinate an inspection of all Mechanical Firestopping systems with the Fire Marshal prior to installation of ceilings, walls, etc.

3.2. PREPARATION

A. Clean surfaces to be in contact with penetration seal materials of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or the required fire resistance.

3.3. INSTALLATION

A. Install penetration seal materials in accordance with printed instructions of the UL Fire Resistance Directory and in accordance with manufacturer's instruction.

B. Seal holes or voids made by penetrations to ensure an effective smoke barrier.

C. Protect materials from damage on surfaces subject to traffic.

D. When large openings are created in walls or floors to permit installation of pipes, ducts, or other items, close unused portions of opening with firestopping materials tested for the application. See UL Fire Resistance Directory or Section 3.6 of this document.

1. Install smoke stopping as specified for firestopping.

3.4. FIELD QUALITY CONTROL

A. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas.

B. Keep areas of work accessible until inspection by applicable code authorities.

C. Perform under this section patching and repairing of firestopping caused by cutting or penetration by other trades.

D. ADJUSTING AND CLEANING

E. Clean up spills of liquid components.

F. Neatly cut and trim materials as required.

G. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

3.5. SYSTEMS AND APPLICATION SCHEDULES*

PENETRATING ITEM	CONCRETE	GYPSUM	WOOD FLOOR/CEILING
Metal Pipe	CAJ1001 CP25S/L, CP25N/S CAJ1006 CS-195+, FS-195+ CAJ1007 FS-195+, 1-inch& 2-inch Wide CAJ1009 2000, 2000+, 2003 CAJ1010 2000, 2000+, 2003 CAJ1012 2000, 2000+, 2003 CAJ1013 2000, 2000+, 2003 CAJ1014 2000, 2000+, 2003 CAJ1015 2000, 2000+, 2003 CAJ1017 FD 150 CAJ1021 FD 150 CAJ1027 MPS-2+ CAJ1044 CP 25WB+ CAJ1052 CP 25S/L, CP 25N/S CAJ1058 2000, 2000+, 2003 CAJ1060 2000, 2000+, 2003 CAJ1063 2000, 2000+, 2003 CAJ1066 CP 25N/S,CP 25S/L, CP 25WB+ CAJ1091 CP 25N/S,CP 25S/L, CP 25WB+ CAJ1092 CP 25WB+ CAJ1112 FS-195+ CAJ1160 CP 25S/L, CP 25N/S CAJ1175 CP 25WB+ CAJ1176 CP 25WB+ CAJ1188 2000+ CBJ1020 CS-195+, FS-195+ CBJ1021 CS-195+, MPS-2+ CBJ1031 2001 CBJ1032 2001 FA1002 CP 25WB+ WJ1010 CP25WB+ WJ1023 2001	WL1001 CP 25 WL1002 FS-195+ WL1003 CP 25WB+,CP 25N/S WL1008 2000+ WL1009 2000+ WL1010 2000+ WL1016 CP 25WB+ WL1017 CP 25WB+,CP 25N/S WL1032 CP 25WB+,CP 25N/S WL1036 FD 150 WL1037 CS-195+,FS-195+ WL1067 CP 25N/S WL1073 CP 25WB+ WL1080 MPS2+ WL1082 2000+	FC1002 CP 25 FC1003 2000,2000+,20003 FC1006 CP 25WB+
Non-Metallic	CAJ2001 FS-195+, 1-inch& 2-inch WIDE, PPD'S CAJ2002 FS-195+ CAJ2003 CS-195+, FS-195+ CAJ2005 FS-195 CAJ2006 FS-195+ CAJ2013 FS-195+ CAJ2019 2000, 2000+, 2003 CAJ2027 FS-195+, CP 25N/S, CP 25S/L, CP 25WB+ CAJ2028 FS-195, MPS-2+ CAJ2029 FS-195+, PPD'S CAJ2030 CS-195+, FS-195+ CAJ2040 FS-195+, CP 25WB+ CAJ2044 FS-195+, CP 25N/S, CP 25S/L CP 25 WB+ CAJ2090 FS-195+ CAJ2177 FS-195+, PPD'S FA2001 FS-195+, PPD'S FS2002 CS-195+, FS-195+, MPS-2+, PPD'S FA2011 FS-195+ WJ2012 FS-195+ 1-inch WIDE	WL2002 FS-195+, PPD'S WL2003 FS-195+ WL2004 FS-195+ WL2005 FS-195+ 4' WIDE WL2006 FS-195+ WL2013 FS-195+ WL2031 CS-195+, FS-195+ WL2032 CS-195+, FS-195+ WL2033 FS-195+ WL2073 FS-195+ 1-inch WIDE	FC2002 FS-195+, PPD'S FC2007 FS-195+, PPD'S FC2008 FS-195+ FC2009 FS-195+, PPD'S FC2024 FS-195 FC2026 FS-195+ FC2028 FS-195, 1' & 2-inch WIDE, PPD'S

PENETRATING ITEM	CONCRETE	GYPSUM	WOOD FLOOR/CEILING
Insulated Metallic Pipe	CAJ5001 CP 25N/S, CP 25S/L, CP 25WB+ CAJ5002 FS-195+ CAJ5003 FS-195+ CAJ5005 MPS-2+ CAJ5009 2000+, 2003 CAJ5017 FS-195+, CP 25 CAJ5022 FS-195+ CAJ5024 FS-195+ CAJ5030 CS-195+, FS-195+ CAJ5041 2000, 2000+, 2003 CAJ5060 CP 25WB+ CAJ5074 2000+ CBJ5002 CP 25 CBJ5003 FS-195+ FA5001 FS-195+, CP 25WB+	WL5001 FS-195+ WL5002 FS-195+ WL5009 FS-195+ WL5010 FS-195+ WL5011 CP 25WB+ WL5032 2000+ WL5038 CP 25WB+ WL5039 CP 25WB+ WL5040 CP 25WB+ WL5045 CP 25WB+ WL5053 2000+	FC5002 FS-195+ FC5008 FS-195+
Miscellaneous Mechanical HVAC Ducts	CAJ7001 CP 25N/S CP 25S/L CAJ7003 CP 25WB+ CAJ7009 DUCT WRAP, BULK PUTTY		FC7001 CP 25S/L, CP 25N/S
Mixed Penetrating Items Combos	CAJ8001 CS-195+ FS-195 CAJ8003 2000, 2000+, 20003 CAJ8004 2000, 2000+, 20003 CAJ8006 2001 CAJ8013 FS-195+, CP 25 CBJ8004 CS-195, FS-195+ CBJ8005 CS-195+, MPS-2+ CBJ8008 2001 FA8001 FS-195+, CP 25WB+	WL8002 CS-195+, FS-195+	

*Underwriter's Laboratories, Inc., Fire Resistance Directory.

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SECTION 23 05 00
COMMON WORK RESULTS FOR HVAC

PART 1. GENERAL

1.1. SUMMARY

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Provide all labor, materials, equipment, and services necessary for and incidental to the complete installation and operation of all mechanical work.

C. Unless otherwise specified, all submissions shall be made to, and acceptances and approvals made by the Engineer.

D. Contract Drawings are generally diagrammatic and all offsets, fittings, transitions and accessories are not necessarily shown. Furnish and install all such items as may be required to fit the work to the conditions encountered. Arrange piping, ductwork, equipment, and other work generally as shown on the contract drawings, providing proper clearance and access. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawings for approval in accordance with Submittals specified below. The right is reserved to make reasonable changes in location of equipment, piping, and ductwork, up to the time of rough-in or fabrication.

E. Conform to the requirements of all rules, regulations and codes of local, state and federal authorities having jurisdiction.

F. Coordinate the work under Division 23 with the work of all other construction trades.

G. Be responsible for all construction means, methods, techniques, procedures, and phasing sequences used in the work. Furnish all tools, equipment and materials necessary to properly perform the work in first class, substantial, and workmanlike manner, in accordance with the full intent and meaning of the contract documents.

1.2. PERMITS AND FEES

A. Obtain all permits and pay taxes, fees and other costs in connection with the work. File necessary plans, prepare documents, give proper notices and obtain necessary approvals. Deliver inspection and approval certificates to Owner prior to final acceptance of the work.

B. Permits and fees shall comply with the Division 01, General Requirements of the specification.

1.3. EXAMINATION OF SITE

A. Examine the site, determine all conditions and circumstances under which the work must be done, and make all necessary allowances for same. No additional cost to the Owner will be permitted for contractors' failure to do so.

B. Examine and verify specific conditions described in individual specifications sections.

C. Verify that utility services are available, of the correct characteristics, and in the correct locations.

1.4. CONTRACTOR QUALIFICATION

A. Any Contractor or Subcontractor performing work under Division 23 shall be fully qualified and acceptable to the Architect/Engineer and Owner. Submit the following evidence when requested:

1. A list of not less than five comparable projects which the Contractor completed.

2. Letter of reference from not less than three registered professional engineers, general contractors or building owners.

3. Local and/or State License, where required.

4. Membership in trade or professional organizations where required.

B. A Contractor is any individual, partnership, or corporation, performing work by contract or subcontract on this project.

C. Acceptance of a Contractor or Subcontractor will not relieve the Contractor or subcontractor of any contractual requirements or his responsibility to supervise and coordinate the work, of various trades.

1.5. MATERIALS AND EQUIPMENT

A. Materials and equipment installed as a permanent part of the project shall be new, unless otherwise indicated or specified, and of the specified type and quality.

B. Where material or equipment is identified by proprietary name, model number and/or manufacturer, furnish named item, or its equal, subject to approval by Engineer. Substituted items shall be equal or better in quality and performance and must be suitable for available space, required arrangement, and application. Submit all data necessary to determine suitability of substituted items, for approval.

C. The suitability of named item only has been verified. Where more than one item is named, only the first named item has been verified as suitable. Substituted items, including items other than first named shall be equal or better in quality and performance to that of specified items, and must be suitable for available space, required arrangement and application. Contractor, by providing other than the first named manufacturer, assumes responsibility for all necessary adjustments and modifications necessary for a satisfactory installation. Adjustments and modifications shall include but not be limited to electrical, structural, support, and architectural work.

D. Substitution will not be permitted for specified items of material or equipment where noted.

E. All items of equipment furnished shall have a service record of at least five (5) years.

1.6. FIRE SAFE MATERIALS

A. Unless otherwise indicated, materials and equipment shall conform to UL, NFPA and ASTM standards for fire safety with smoke and fire hazard rating not exceeding flame spread of 25 and smoke developed of 50.

1.7. REFERENCED STANDARDS, CODES AND SPECIFICATIONS

A. Specifications, Codes and Standards listed below are included as part of this specification, latest edition.

B.	AABC		Associated Air Balance Council
C.	AMCA		Air Movement and Control Association
D.	ANSI	-	American National Standards Institute
E.	ARI	-	Air Conditioning and Refrigeration Institute
F.	ASHRAE	-	American Society of Heating, Refrigerating and Air Conditioning Engineers
G.	ASME	-	American Society of Mechanical Engineers
H.	ASPE	-	American Society of Plumbing Engineers
I.	ASTM	-	American Society for Testing and Materials
J.	CSD		Control and Safety Devices
K.	CTI	-	Cooling Tower Institute
L.	DNREC	-	Delaware Department of Natural Resources
M.	IBC	-	International Building Code
N.	IEEE	-	Institute of Electrical and Electronics Engineers
O.	MSSP	-	Manufacturers Standards Society of the Valve and Fittings Industry
P.	NEC	-	National Electrical Code
Q.	NEMA	-	National Electrical Manufacturers Association
R.	NFPA	-	National Fire Protection Association
S.	SMACNA	-	Sheet Metal and Air Conditioning Contractors National Association
T.	UL	-	Underwriters' Laboratories

U. State of Delaware Fire Protection Regulations.

V. All mechanical equipment and materials shall comply with the codes and standards listed in the latest edition of ASHRAE HVAC Applications Handbook, Chapter entitled Codes and Standards.

1.8. SUBMITTALS, REVIEW AND ACCEPTANCE

A. Equipment, materials, installation, workmanship and arrangement of work are subject to review and acceptance. No substitution will be permitted after acceptance of equipment or materials except where such substitution is considered by the Engineer to be in best interest of Owner.

B. After acceptance of Material and Equipment List, submit six (6) copies or more as required under General Conditions of complete descriptive data for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, wiring diagrams, installation instructions, and any other information necessary to indicate complete compliance with Contract Documents. Edit submittal data specifically for application to this project.

C. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and any electrical requirements for equipment submitted. Contractor shall be responsible for correctness of all submittals.

D. Submittals will be reviewed for general compliance with design concept in accordance with contract documents, but dimensions, quantities, or other details will not be verified.

E. Identify submittals, indicating intended application, location and service of submitted items. Refer to specification sections or paragraphs and drawings where applicable. Clearly indicate exact type, model number, style, size and special features of proposed item. Submittals of a general nature will not be acceptable. For substituted items, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The contractor shall be responsible for corrective action and maintaining the specification requirements if differences have not been clearly indicated in the submittal.

F. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable. Call attention, in writing, to deviation from contract requirements.

G. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted. Use only final or corrected submittals and data prior to fabrication and/or installation.

H. For any submittal requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.

I. For resubmissions, the Contractor must address in writing all of the Engineer's comments on the original submission to verify compliance.

1.9. SHOP DRAWINGS

A. Prepare and submit shop drawings for all mechanical equipment, specially fabricated items, modifications to standard items, specially designed systems where detailed design is not shown on the contract drawings, or where the proposed installation differs from that shown on contract drawings.

B. Submit data and shop drawings including but not limited to the list below, in addition to provisions of the paragraph above. Identify all shop drawings by the name of the item and system and the applicable specification paragraph number and drawing number.

C. Every submittal including, but not limited to the list below, shall be forwarded with its own transmittal as a separate, distinct shop drawing. Grouping of items/systems that are not related shall be unacceptable.

D. Items and Systems

1. Access Doors/Panels including layouts and locations
2. Air Distribution Systems
3. Automatic Temperature Control Systems and Equipment
4. Central Control and Monitoring Systems (CCMS) and Equipment
5. Chiller (Refurbished)
6. Cooling Tower (Refurbished)
7. Coordinated Drawings
8. Drip Pans
9. Duct Materials
10. Fans
11. Filters
12. Fire Stopping - Methods and Materials
13. Identification Systems
14. Pipe Guides and Anchors
15. Pipe Materials Including Itemized Schedules
16. Preliminary Testing and Balancing Reports

17. Pump

18. Refrigerant Monitoring Systems

19. Screen shots of ATC System Graphics

20. Self-Contained Breathing Apparatus (SCBA)

21. Test Certificates

22. Thermometers and Gauges

23. Variable Frequency Drive Motor Bearing Protective Rings

24. Variable Speed Drives

25. Water Treatment Services

26. Weatherproof Assembly Components

27. Wiring Diagrams, Flow Diagrams and Operating Instructions

E. Contractor, additionally, shall submit for review any other shop drawings as required by the Engineer. No item shall be delivered to the site, or installed, until the Contractor has received a submittal from the Engineer marked Reviewed or Comments Noted. After the proposed materials have been reviewed, no substitution will be permitted except where approved by the Engineer.

F. For any shop drawing requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.

1.10. SUPERVISION AND COORDINATION

A. Provide complete supervision, direction, scheduling, and coordination of all work under the Contract, including that of subcontractors.

B. Coordinate rough-in of all work and installation of sleeves, anchors, and supports for piping, ductwork, equipment, and other work performed under Division 23.

C. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

D. Coordinate electrical work required under Division 23 with that under Division 26. Coordinate all work under Division 23 with work under all other Divisions.

E. Supply services of an experienced (10 year minimum) and competent Project Manager to be in constant charge of work at site.

F. Where a discrepancy exists within the specifications or drawings or between the

specifications and drawings, the more stringent (or costly) requirement shall apply until clarification can be obtained from the Engineer. Failure to clarify such discrepancies with the Engineer will not relieve the Contractor of the responsibility of conforming to the requirements of the Contract.

G. Failure of contractor to obtain a full and complete set of contract documents (either before or after bidding) will not relieve the contractor of the responsibility of complying with the intent of the contract documents.

H. Coordinate installation of large equipment requiring positioning before closing in building. Where required arrange for manufacturer to ship equipment in modules.

1.11. CUTTING AND PATCHING

A. Accomplish all cutting and patching necessary for the installation of work under Division 23. Damage resulting from this work to other work already in place, shall be repaired at Contractor's expense. Where cutting is required, perform work in neat and workmanlike manner. Restore disturbed work to match and blend with existing construction and finish, using materials compatible with the original. Use mechanics skilled in the particular trades required.

B. Do not cut structural members without approval from the Architect or Engineer.

1.12. PENETRATION OF WATERPROOF CONSTRUCTION

A. Coordinate the work to minimize penetration of waterproof construction, including exterior walls, and interior waterproof construction. Where such penetrations are necessary, furnish and install all necessary curbs, sleeves, flashings, fittings and caulking to make penetrations absolutely watertight.

B. Furnish and install pitch pockets or weather tight curb assemblies where required.

C. Furnish and install curbs, vent assemblies, and duct sleeves specifically designed for application to the particular roof construction, and install in accordance with the manufacturer's instructions. The Contractor shall be responsible for sleeve sizes and locations. All roof penetrations shall be installed in accordance with manufacturer’s instructions, SMACNA, and as required by other divisions of these specifications.

1.13. CONCRETE AND MASONRY WORK

A. Furnish and install concrete and masonry work for equipment foundations, supports, pads, and other items required under Division 23. Perform work in accordance with requirements of other applicable Divisions of these specifications.

B. Concrete shall test not less than 3,000 psi compressive strength after 28 days.

C. Grout shall be non-shrink, high strength mortar, free of iron of chlorides and suitable for use in contact with all metals, without caps or other protective finishes. Apply in accordance with manufacturer's instructions and standard grouting practices.

1.14. CONNECTIONS AND ALTERATIONS TO EXISTING WORK

A. Unless otherwise noted on the drawings, where existing mechanical work is removed, pipes, valves, ductwork, etc., shall be removed, including hangers, to a point below finished floors or behind finished walls and capped. Such point shall be far enough behind finished surfaces to allow for installation of normal thickness of required finish material.

B. Where work specified in Division 23 connects to existing equipment, piping, ductwork, etc., Contractor shall perform all necessary alterations, cuttings, fittings, etc., of existing work as may be necessary to make satisfactory connections between new and existing work, and to leave completed work in a finished and workmanlike condition.

C. Where the work specified under Division 23, or under other Divisions, requires relocation of existing equipment, piping, ductwork, etc., Contractor shall perform all work and make necessary changes to existing work as may be required to leave completed work in a finished and workmanlike condition. Where existing insulation is disturbed, replace insulation where removed or damaged equal to existing, in type, thickness, density, finish and thermal resistance (R-value) value.

D. Where the relocation of existing equipment is required for access or the installation of new equipment, the contractor shall temporarily remove and/or relocate and re-install as required to leave the existing and new work in a finished and workman like condition.

1.15. DEMOLITION

A. Unless otherwise noted all existing equipment, piping, ductwork, etc., shall remain.

B. Where existing equipment is indicated to be removed, all associated piping, conduit, power, controls, insulation, hangers, ductwork, supports and housekeeping pads, etc., patch, paint and repair walls/roof/floor to match existing and/or new finishes.

C. Provide necessary piping, valves, traps, temporary feeds, drips, etc., as required. Drain and refill piping systems as often as necessary to accommodate phasing and to minimize time lengths of outages.

D. The Contractor shall be responsible for visiting the site and determining the existing conditions in which the work is to be performed.

E. Where any abandoned pipes in existing floors, walls, pipe tunnels, ceilings, etc., conflict with new work, remove abandoned pipes as necessary to accommodate new work.

F. The location of all existing equipment, piping, ductwork, etc., indicated is approximate only and shall be checked and verified. Install all new mechanical/plumbing/fire protection work to connect to or clear existing work as applicable.

G. Maintain egress at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and the authorities having jurisdiction.

H. Make provisions and include in bid all costs associated with confined entry/space requirements in cooling tower and all other applicable OSHA and regulations.

I. Where required to maintain the existing systems in operation, temporarily backfeed

existing systems from new equipment. Contractor shall temporarily extend existing piping systems to new piping systems with the appropriate shut-off valves.

J. At completion of project all temporary piping, valves, controls, etc., shall be removed in their entirely.

K. Existing piping, equipment, ductwork, materials, etc., not required for re-use or re-installation in this project, shall be removed from the project site.

L. Deliver to the Owner, on the premises where directed, existing equipment and materials which are removed and which are desired by the Owner or are indicated to remain the property of the Owner.

M. All other materials and equipment which are removed shall become property of the Contractor and shall be promptly removed, from the premises, and disposed of by the Contractor, in an approved manner. Contractor shall be responsible for proper disposal of all removed equipment containing refrigerants. Contractor shall include in his bid all cost associated with the evacuation, removal and disposal of all existing equipment containing refrigerants in accordance with EPA and Health Department requirements. Where existing split systems or ductless units are indicated to be relocated, extend refrigeration piping, power, and control wiring to the same.

N. Where piping and/or ductwork is removed, remove all pipe or ductwork hangers which were supporting the removed piping or ductwork. Patch the remaining penetration voids with like materials and paint to match existing construction.

O. Where required, provide and coordinate removal and re-installation of existing equipment. Take care to protect materials and equipment indicated for reuse. Contractor shall repair or replace items which are damaged. Contractor shall have Owner's representative present to confirm condition of equipment prior to demolition.

P. Before demolition begins, and in the presence of the Owners representative, test and note all deficiencies in all existing systems affected by demolition but not completely removed by demolition. Provide a copy of the list of system deficiencies to the Owner and the Engineer. Videotape existing conditions in each space prior to beginning demolition work.

Q. The Owner shall have the first right of refusal for all fixtures, devices and equipment removed by the Contractor.

R. All devices and equipment designated by the Owner to remain the property of the Owner shall be moved and stored by the Contractor at a location on site as designated by the Owner. It shall be the Contractor's responsibility to store all devices and equipment in a safe manner to prevent damage while stored.

S. All existing equipment refused by the Owner shall become the property of the Contractor and shall be removed from the site by the Contractor in a timely manner and disposed of in a legal manner.

T. 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.

U. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

V. Terminate services and utilities in accordance with local laws, ordinances, rules and regulations.

W. Where hydronic system piping and equipment is removed, Contractor shall be responsible for proper disposal of all contained fluids containing glycol (ethylene or propylene), hazardous waste and water treatment chemicals. Contractor shall include in his bid all associated costs with the removal, testing, and disposal of hydronic system fluid in accordance with EPA, Health Department, and the Local Authority Having Jurisdiction.

1.16. DRIVE GUARDS

A. Provide safety guards on all exposed belt drives, motor couplings, and other rotating machinery. Provide fully enclosed guards where machinery is exposed from more than one direction.

B. When available, guards shall be factory fabricated and furnished with the equipment. Otherwise fabricate guards of heavy gauge steel, rigidly braced, removable, and finish to match equipment served. Provide openings for tachometers. Guards shall meet local, State and O.S.H.A. requirements.

1.17. VIBRATION ISOLATION

A. Furnish and install vibration isolators, flexible connections, supports, anchors and/or foundations required to prevent transmission of vibration from equipment, piping or ductwork to building structure. See Division 23 Section 23 05 48 “Vibration and Seismic Controls for HVAC Piping and Equipment”.

1.18. ALTERNATES

A. Refer to Division 01 Section 01 23 00 “Alternates” for description of work under this section affected by alternates.

1.19. DEFINITIONS

A. Approve - to permit use of material, equipment or methods conditional upon compliance with contract documents requirements.

B. Furnish and install or provide means to supply, erect, install, and connect to complete for readiness for regular operation, the particular work referred to.

C. Contractor means the mechanical contractor and any of his subcontractors, vendors, suppliers, or fabricators.

D. Piping includes pipe, all fittings, valves, hangers, insulation, identification, and other accessories relative to such piping.

E. Ductwork includes duct material, fittings, hangers, insulation, sealant, identification and

other accessories

F. Concealed means hidden from sight in chases, formed spaces, shafts, hung ceilings, or embedded in construction.

G. Exposed means not installed underground or concealed as defined above.

H. Invert Elevation means the elevation of the inside bottom of pipe.

I. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceiling, and unexcavated spaces.

J. Review - limited observation or checking to ascertain general conformance with design concept of the work and with information given in contract documents. Such action does not constitute a waiver or alteration of the contract requirements.

K. Building Line: Exterior wall of building.

1.20. MINIMUM EFFICIENCY REQUIREMENTS

A. All heating, ventilating, and air conditioning equipment shall be manufactured to provide the minimum efficiency requirements as specified in ASHRAE Standard 90.1, latest edition.

B. All piping, ductwork, and equipment insulation shall comply with ASHRAE Standard 90.1, latest edition.

C. All mechanical devices, controls, accessories, and components shall be manufactured to provide the minimum efficiency requirements as specified in ASHRAE Standard 90.1, latest edition.

1.21. SYSTEM INTEGRATION

A. For all HVAC equipment specified to be provided with packaged controls and interfaced with the automatic temperature control system, provide system integration between the equipment manufacturer and the automatic temperature control subcontractor.

B. HVAC equipment submittals requiring system integration as defined above must identify all required system integration points.

C. HVAC equipment manufacturers must coordinate with ATC subcontractor regarding system integration prior to submitting on the equipment.

D. A system integration meeting must be arranged by the Mechanical Contractor and include, but not be limited to the systems integrator for the HVAC equipment manufacturer and the ATC Subcontractor. This portion of systems integration must occur prior to HVAC equipment being delivered to the project.

E. Once the HVAC equipment is on site, a second systems integration meeting must be arranged by the Mechanical Contractor to coordinate the packaged controls with the ATC system. The HVAC equipment manufacturer’s representative familiar with system

integration and the ATC subcontractor familiar with programming must be present.

F. A final system integrations meeting shall occur once all equipment is in place and ready for operation. The Mechanical Contractor, the HVAC equipment systems' integrator, and the ATC Subcontractor shall meet on site to jointly program, schedule, verify points, interlock devices, and fully set up all systems integration components.

G. All systems integration coordination, programming, and graphics must be completed prior to requesting commissioning and/or inspections by the Engineer of Record.

PART 2. ELECTRICAL REQUIREMENTS

2.1. GENERAL MOTOR AND ELECTRICAL REQUIREMENTS

A. Furnish and install control and interlock wiring for the equipment furnished. In general, power wiring and motor starting equipment will be provided under Division 26. Carefully review the contract documents to coordinate the electrical work under Division 23 with the work under Division 26. Where the electrical requirements of the equipment furnished differ from the provisions made under Division 26, make the necessary allowances under Division 23. Where no electrical provisions are made under Division 26, include all necessary electrical work under Division 23.

B. All electrical work performed under Division 23 shall conform to the applicable requirements of Division 26 and conforming to the National Electrical Code. All wiring, conduit, etc., installed in ceiling plenums must be plenum rated per NFPA and the International Building Code.

C. Provide wiring diagrams with electrical characteristics and connection requirements.

D. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than five (5) horsepower.

E. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weatherproof covering. For extended outdoor storage, remove motors from equipment and store separately.

F. All motors shall be furnished with visible nameplate indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor and efficiency.

G. Motors located in exterior locations, wet air streams, cooling tower, and outdoors shall be totally enclosed weatherproof epoxy-treated type.

H. Nominal efficiency and power factor shall be as scheduled at full load and rated voltage when tested in accordance with IEEE 112.

I. Brake horsepower load requirement at specified duty shall not exceed 85 percent of nameplate horsepower times NEMA service factor for motors with 1.0 and 1.15 service factors.

J. All single phase motors shall be provided with thermal protection: Internal protection

shall automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature ratings of motor insulation. Thermal protection device shall automatically reset when motor temperature returns to normal range, unless otherwise indicated.

2.2. MOTORS AND CONTROLS

A. Motors and controls shall conform to the latest requirements of IEEE, NEMA, NFPA-70 and shall be UL listed. Motor sizes are specified with the driven equipment. Motor starting and control equipment is specified either with the motor which is controlled or in an electrical specification section. The Contractor is advised to consult all specification sections to determine responsibility for motors and controls.

B. Motors shall be designed, built and tested in accordance with the latest revision of NEMA Standard MG l.

C. Motors used with variable-frequency controllers shall have ratings, characteristics, and features coordinated with and approved by the variable frequency controller (drive) manufacturer. As a minimum the following shall apply to variable frequency controlled motors:

1. Motors shall be manufactured to withstand peak voltages of 1600 volts with .1 microsecond rise time per NEMA MG-1.

2. Critical vibration frequencies of motor shall not be within operating range of variable frequency controller output.

3. Temperature rise: Match rating for Class B insulation.

4. Insulation: Class F.

5. Thermal Protection: Conform to MG1 requirements for thermally protected motors.

D. Motors shall be suitable for use under the conditions and with the equipment to which applied, and designed for operation on the electrical systems specified or indicated.

1. Motor capacities shall be such that the horsepower rating and the rated full-load current will not be exceeded while operating under the specified operating conditions. Under no condition shall the motor current exceed that indicated on the nameplates.

2. Motor sizes noted in the individual equipment specifications are minimum requirements only. It is the responsibility of the equipment manufacturers and of the Contractor to furnish motors, electrical circuits and equipment of ample capacity to operate the equipment without overloading, exceeding the rated full-load current, or overheating at full-load capacity under the most severe operating service of this equipment. Motors shall have sufficient torque to accelerate the total WR2 of the driven equipment to operating speed.

3. Motors shall be continuous duty type and shall operate quietly at all speeds and

loads.

4. Motors shall be designed for operation on 60 hertz power service. Unless otherwise specified or shown, motors less than ½ horsepower shall be single phase, and motors ½ horsepower and larger shall be 3 phase unless otherwise noted.

5. Motors shall be mounted so that the motor can be removed without removing the entire driven unit.

E. Single phase motors, smaller than 1/20 horsepower shall be ball or sleeve bearing; drip-proof, totally enclosed or explosion proof, as specified; 120 volts; permanent-split capacitor or shaded pole type. These motors shall not be used for general power purposes, and shall only be provided as built-in components of such mechanical equipment as fans and damper controllers. When approved by the Engineer, deviations from the specifications will be permitted as follows:

1. Open motors may be installed as part of an assembly where enclosure within a cabinet provides protection against moisture.

2. Motors used in conjunction with low voltage control systems may have a voltage rating less than 115 volts.

F. Single phase motors, greater than 1/20 horsepower and less than ½ horsepower shall be ball bearing; drip-proof, totally enclosed or explosion proof, as specified, with Class A or B insulation, as standard with the motor manufacturer; 115 or 120/208/240 volts as required; capacitor start-induction run, permanent split capacitor, or repulsion start-induction run type with minimum efficiency of 70 percent and a minimum full load power of 77 percent.

G. Except as otherwise specified in the various specification sections, 3 phase motors 60 horsepower and smaller shall be NEMA design B squirrel cage induction type meeting the requirements of this paragraph. Motors shall be drip-proof, totally enclosed or explosion proof, as specified or indicated. Insulation shall be Class B or F, at 40 degrees C ambient temperature. Drip-proof motors shall have a 1.15 service factor and totally enclosed and explosion proof motors shall have a service factor of 1.00 or higher. Motors specified for operation at 480, 240, and 208 volts shall be nameplated 460, 230, 200 volts, respectively. Efficiencies and percent power factor at full load for three phase motors shall be not less than the values listed below for premium efficiency motors:

MOTOR NAMEPLATE	MINIMUM PERCENT EFFICIENCY AT NOMINAL SPEED AND RATED LOAD	MINIMUM PERCENT POWER FACTOR
1HP and above to	85.5 percent	84 percent
1-½ HP	86.5 percent	85 percent

MOTOR NAMEPLATE	MINIMUM PERCENT EFFICIENCY AT NOMINAL SPEED AND RATED LOAD	MINIMUM PERCENT POWER FACTOR
2HP	86.5 percent	85 percent
3HP	89.5 percent	86 percent
5HP	89.5 percent	87 percent
7½ HP	91 percent	86 percent
10HP	91.7 percent	85 percent
15HP	93.0 percent	85 percent
20HP	93.0 percent	86 percent
25HP	93.6 percent	85 percent
50HP and above	94.5 percent	88 percent

H. Three phase motors ½ HP or greater shall be the Duty Master XE by Reliance Electric Company, Super-E Premium Efficiency of Baldor Motor and Drives, E-plus Efficient Standard Duty Motor of the Electric Motor Division of Gould, Inc., the MAC II High Efficiency motor of Westinghouse Electric Corp., the equivalent product of General Electric, or approved equal.

I. For motors serving equipment being controlled by a variable speed drive, motor shall be premium efficiency inverter duty rated.

J. Motor frames shall be NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast-iron or aluminum with steel inserts.

K. Control of each motor shall be manual or automatic as specified for each in the various mechanical sections. In general, and unless otherwise specified for a particular item in the various mechanical sections of the specifications, motor starters and controls shall be specified and provided under the various electrical sections of these specifications.

L. Provide manufacturer's warranty for all motors for minimum of 5 years including all labor and materials.

2.3. MOTOR INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors to support shaft regardless of shaft position.

C. Check line voltage and phase and ensure agreement with nameplate. Check that proper thermal overloads have been installed prior to operating motors.

D. Use adjustable motor mounting bases for belt-driven motors.

E. Align pulleys and install belts.

F. Tension belts according to manufacturer's written instructions.

2.4. WIRING DIAGRAMS

A. The Contractor is responsible for obtaining and submitting wiring diagrams for all major items of equipment.

B. Wiring diagrams shall be provided with shop drawings for all equipment requiring electric power.

C. Provide wiring diagrams for all major mechanical items of equipment to electrical contractor and ATC subcontractor for coordination.

2.5. VARIABLE FREQUENCY DRIVE MOTOR BEARING PROTECTIVE RINGS:

A. For all motors driven by a variable frequency PWM drive include a maintenance free, circumferential, conductive micro fiber shaft grounding ring to discharge shaft currents. Grounding rings shall be manufactured by AEGIS SGR or approved equal.

B. Furnish units with one year warranty.

C. Size and select Bearing Protective Rings per the manufacturer requirements based on the motor size, shaft diameter, and shaft shoulder length. For motors with slingers furnish and install NEMA /IEC kit as required.

D. Furnish and apply Colloidal silver shaft coating to all shafts with Bearing Protective Rings to improve shaft voltage discharge capability.

PART 3. EXECUTION

3.1. EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.

B. Install equipment according to approved submittal data. Portions of the work are shown only in diagrammatic form. Refer conflicts to Engineer.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

D. Install mechanical 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.

E. Install equipment giving right of way to piping installed at required slope.

F. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

G. Do not install equipment, ductwork, or piping over electrical gear, electrical panels, motor controllers, and similar electrical equipment. Install equipment, ductwork, and piping to maintain clear space above and in front of all electrical components per the National Electric Code.

3.2. SUPPORTS, HANGERS AND FOUNDATIONS

A. Provide supports, hangers, braces, attachments and foundations required for the work. Support and set the work in a thoroughly substantial and workmanlike manner without placing strains on materials, equipment, or building structure, submit shop drawings for approval. Coordinate all work with the requirements of the structural division.

B. Supports, hangers, braces, and attachments shall be standard manufactured items or fabricated structural steel shapes. All interior hangers shall be galvanized or steel with rust inhibiting paint. For un-insulated copper piping provide copper hanger to prevent contact of dissimilar metals. All exterior hangers shall be constructed of stainless steel utilizing stainless steel rods, nuts, washers, bolts, etc.

C. Concrete housekeeping pads and foundations shall be not less than 4 inches high and shall extend a minimum of 6 inches beyond equipment bases. Provide wire-mesh reinforcement; chamfer exposed edges and corners; and finish exposed surfaces smooth.

D. Where new concrete housekeeping pads are placed on existing concrete, saw cut the existing concrete to the perimeter dimension of the new pad to a depth of ½ inch. Break out the top ½ inch area of the existing concrete. Add stubs of #4 rebar angled into the existing concrete at a depth of approximately 50 percent of the existing slab thickness. The top portion of the rebar stub shall extend into the new pad by approximately 50 percent of its thickness. Furnish one rebar stub per every two square feet of new pad. Chemically bond the new concrete to the existing concrete.

3.3. PROVISIONS FOR ACCESS

A. The contractor shall provide access panels and doors for all concealed equipment, valves, dampers, filters, controls, control devices, damper operators, and other devices requiring maintenance, service, adjustment, balancing or manual operation.

B. Where access doors are necessary, furnish and install manufactured painted steel door assemblies consisting of hinged door, key locks, and frame designed for the particular wall or ceiling construction. Properly locate each door. Door sizes shall be a 12 inches x 12 inches for hand access, 18 inches x 18 inches for shoulder access and 24 inches x 24 inches for full body access where required. Review locations and sizes with Architect prior to fabrication. Mark each access door within finished spaces with a small color coded and numbered tab. Provide a chart or index for identification. Provide U.L. approved and labeled access doors where installed in fire rated walls or ceilings. Doors shall be Milcor Metal Access Doors as manufactured by Inland-Ryerson, Mifab, or approved equal.

1. Acoustical or Cement Plaster: Style B

2. Hard Finish Plaster: Style K or L

i. Masonry or Dry Wall: Style M

C. Access panels, doors, etc. described herein shall be furnished under the section of specifications providing the particular service and to be turned over to the pertinent trade for installation. Coordinate installation with installing contractor. All access doors shall be painted in baked enamel finish to match ceiling or wall finish.

D. Submit shop drawings indicating the proposed location of all access panels/doors. Access doors in finished spaces shall be coordinated with air devices, lighting and sprinklers to provide a neat and symmetrical appearance.

3.4. PAINTING AND FINISHES

A. Provide protective finishes on all materials and equipment. Use coated or corrosion-resistant materials, hardware and fittings throughout the work. Paint bare, untreated ferrous surfaces with rust-inhibiting paint. All exterior components including supports, hangers, nuts, bolts, washers, vibration isolators, etc. shall be stainless steel.

B. Clean surfaces prior to application of insulation, adhesives, coatings, paint, or other finishes.

C. Provide factory-applied finishes where specified. Unless otherwise indicated factory-applied paints shall be baked enamel with proper pretreatment.

D. Protect all finishes and restore any finishes damaged as a result of work under Division 23 to their original condition.

E. The preceding requirements apply to all work, whether exposed or concealed.

F. Remove all construction marking and writing from exposed equipment, ductwork, piping and building surfaces. Do not paint manufacturer's labels or tags.

G. All exposed ductwork, piping, equipment, etc. shall be painted. Colors shall be as stated in this division or as selected by the Owner and conform to ANSI Standards.

H. All exterior ductwork and equipment shall be painted to match wall in color as selected by Owner.

I. All exposed ductwork, piping, equipment, etc. in finished spaces shall be painted. Colors shall be as selected by the Owner and conform to ANSI Standards.

J. All exposed ductwork, piping, equipment, etc., in Mechanical Rooms, where PVC jacketed shall not require painting. Label and identify and color code as specified.

3.5. CLEANING OF SYSTEMS

A. Thoroughly clean systems after satisfactory completion of pressure tests and before permanently connecting fixtures, equipment, traps, strainers, and other accessory items.

Blow out and flush piping until interior surfaces are free of foreign matter.

B. Flush piping in re-circulating water systems to remove cutting oil, excess pipe joint compound, solder slag and other foreign materials. Do not use system pumps until after cleaning and flushing has been accomplished to the satisfaction of the Engineer. Employ chemical cleaners, including a non-foaming detergent, not harmful to system components. After cleaning operation, final flushing and refilling, the residual alkalinity shall not exceed 300 parts per million. Submit a certificate of completion to Engineer stating name of Service Company used.

C. Maintain strainers and dirt pockets in clean condition.

D. Clean fans and ductwork at completion of work.

E. Pay for labor and materials required to locate and remove obstructions from systems that are clogged with construction refuse after acceptance. Replace and repair work disturbed during removal of obstructions.

F. Leave systems clean, and in complete running order.

G. All HVAC piping/equipment strainers must be pulled and cleaned prior to substantial completion. In addition six (6) months after substantial completion all HVAC piping/equipment strainers must be pulled and cleaned a second time. Document and submit verification of strainer cleaning to Engineer, Owner, and Construction Manager.

3.6. COLOR SELECTION

A. Color of finishes shall be as selected by the Owner.

B. Submit color of factory-finished equipment for acceptance prior to ordering.

3.7. PROTECTION OF WORK

A. Protect work, material and equipment from weather and construction operations before and after installation. Properly store and handle all materials and equipment.

B. Cover temporary openings in piping, ductwork, and equipment to prevent the entrance of water, dirt, debris, or other foreign matter. Deliver pipes and tubes with factory applied end caps.

C. Cover or otherwise protect all finishes.

D. Replace damaged materials, devices, finishes and equipment.

E. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, where stored inside.

3.8. OPERATION OF EQUIPMENT

A. Clean all systems and equipment prior to initial operation for testing, balancing, or other purposes. Lubricate, adjust, and test all equipment in accordance with manufacturer's instructions. Do not operate equipment unless all proper safety devices or controls are

operational. Provide all maintenance and service for equipment that is authorized for operation during construction.

B. Where specified, or otherwise required, provide the services of the manufacturer's factory-trained servicemen or technicians to start up the equipment. Where factory start-up of equipment is not specified, provide field start-up by qualified technician.

C. Submit factory start-up sheets or field start-ups sheets for all equipment prior to the commencement of testing and balancing work. Testing and balancing work shall not commence until start-up reports have been completed, reviewed by Engineer and forwarded to Testing and Balancing Agency.

D. Do not use mechanical systems for temporary services or temporary conditioning during construction, unless approved by Owner in writing. Refer to Division 01 Section "Temporary Facilities and Controls" for temporary heating/cooling during construction.

E. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items such as filters.

3.9. DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Record demonstration and training video recordings. Record each training module separately.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Engineer

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

D. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

E. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

3.10. IDENTIFICATIONS, FLOW DIAGRAMS, ELECTRICAL DIAGRAMS AND OPERATING INSTRUCTIONS

A. Contractor shall submit for approval schematic piping diagrams of each piping system installed in the building. Diagrams shall indicate the location and the identification number of each valve in the particular system. Following approval by all authorities, the diagrams shall be framed, mounted under safety glass and hung in each Mechanical Room where directed. Contractor shall deliver the tracing or sepia from which the diagrams were reproduced to the Owner.

B. All valves shall be plainly tagged. For any bypass valves, install sign indicating valve position as “Normally Open” or “Normally Closed” as required.

C. All items of equipment, including motor starters, disconnects and ATC panels shall be furnished with white on black plastic permanent identification cards. Lettering shall be a minimum of ¼ inch high. Identification plates shall be secured, affixed to each piece of equipment, starters, disconnects, panels by screw or adhesive (tuff bond #TB2 or as approved equal).

D. Provide six (6) copies of operating and maintenance instructions for all principal items of equipment furnished. This material shall be bound as a volume of the Record and Information Booklet as hereinafter specified.

E. All piping and ductwork installed under this contract shall be stenciled with direction of flow arrows and with stenciled letters naming each pipe and ductwork and service. Refer to Division 23 Section 23 05 05 "HVAC Piping, Fittings, Valves, Etc." and Division 23 Section 23 30 00 "HVAC Air Distribution". Color-code all direction of flow arrows and labels. In finished spaces omit labeling and direction of flow arrows. Paint in color as selected by Architect.

F. Submit list of wording, symbols, letter size, and color coding for mechanical identification. Submit samples of equipment identification cards, piping labels, ductwork labels, and valve tags to Engineer for review prior to installation.

G. Provide at least hours of straight time instruction to the operating personnel. This instruction period shall consist of not less than two (2) consecutive 4 hour days. Time of instruction shall be designated by the Owner. Additional instruction time for the automatic temperature control (ATC) system is specified in Division 23 Section 23 09 00 "Instrumentation & Control for HVAC".

H. Contractor shall demonstrate Sequences of Operation of all equipment in presence of Owner's representative, Engineer, and ATC subcontractor.

3.11. WALL AND FLOOR PENETRATION

A. All penetrations of partitions, ceilings, and floors by ducts, piping or conduit under Division 23 shall be sleeved, sealed, and caulked airtight for sound and air transfer control. Penetrations of mechanical room partitions, ceilings, and floors shall be as specified in Division 23 Section 23 05 48 "Vibration & Seismic Controls for HVAC Piping and Equipment".

B. All penetration of fire rated assemblies shall be sleeved, sealed, caulked and protected to maintain the rating of the wall, roof, or floor. Fire Marshal approved U.L. assemblies shall be utilized. See Division 07 Section 07 84 13 "Penetration Firestopping".

C. Where piping extends through exterior walls or below grade, provide waterproof pipe penetration seals, as specified in another division of these specifications.

D. Provide pipe escutcheons and duct flanges for sleeved pipes and ducts in finished areas.

E. Piping sleeves:

1. Galvanized steel pipe, standard weight where pipes are exposed and roofs and concrete and masonry walls. On exterior walls provide anchor flange welded to

perimeter.

2. Twenty-two (22) gauge galvanized steel elsewhere.

F. Ductwork sleeves: 20 gauge galvanized steel.

G. Extend all floor sleeves through floor at least 3/4-inches above finished floor, caulk sleeve the entire depth and furnish and install floor plate.

3.12. RECORD DRAWINGS

A. Upon completion of the mechanical installations, the Contractor shall deliver to the Engineer one complete set of prints of the mechanical contract drawings which shall be legibly marked in red pencil to show all changes and departures of the installation as compared with the original design. They shall be suitable for use in preparation of Record Drawings.

B. Contractor shall incorporate all sketches, addendums, value engineering, change orders, etc., into record drawings prior to delivering to Engineer.

3.13. WARRANTY

A. Contractor's attention is directed to warranty obligations contained in the GENERAL CONDITIONS.

B. The above shall not in any way void or abrogate equipment manufacturer’s guarantee or warranty. Certificates of equipment manufacturer’s warranties shall be included in the operations and maintenance manuals.

C. The Contractor guarantees for a two year period from the time of final acceptance by the Owner.

1. That the work contains no faulty or imperfect material or equipment or any imperfect, careless, or unskilled workmanship.

2. That all work, equipment, machines, devices, etc. shall be adequate for the use to which they are intended, and shall operate with ordinary care and attention in a satisfactory and efficient manner.

3. That the contractor will re-execute, correct, repair, or remove and replace with proper work, without cost to the Owner, any work found to be deficient. The contractor shall also make good all damages caused to their work or materials in the process of complying with this section.

4. That the entire work shall be water-tight and leak-proof.

3.14. LUBRICATION

A. All bearings, motors, and all equipment requiring lubrication shall be provided with accessible fittings for same. Before turning over the equipment to the Owner, the Contractor shall fully lubricate each item of equipment, shall provide one year's supply of lubricant for each, and shall provide Owner with complete written lubricating

instructions, together with diagram locating the points requiring lubrication. Include this information in the Record and Information Booklet.

B. In general, all motors and equipment shall be provided with grease lubricated roller or ball bearings with Alemite or equal accessible or extended grease fittings and drain plugs.

3.15. OPERATIONS AND MAINTENANCE MANUALS

A. The Contractor shall have prepared six (6) hardcopies and one (1) electronic copy of the Operations and Maintenance Manuals and deliver these copies of the booklet to the Owner. The booklet shall be as specified herein. The booklet must be approved and will not be accepted as final until so stamped.

B. The booklet shall be bound in a three ring loose-leaf binder similar to National No. 3881 with the following title lettered on the front: Operations and Maintenance Manuals – Delcastle High School Chiller/Cooling Tower Refurbishment - HVAC. No sheets larger than 8-1/2 inches x 11 inches shall be used, except sheets that are neatly folded to 8-1/2 inches x 11 inches and used as a pull-out. Provide divider tabs and table of contents for organizing and separating information.

C. Provide the following data in the booklet:

1. As first entry, an approved letter indicating the starting/ending time of Contractor’s warranty period.

2. Maintenance operation and lubrication instructions on each piece of equipment furnished.

3. Complete catalog data on each piece of heating and air conditioning equipment furnished including approved shop drawing.

4. Manufacturer's extended limited warranties on equipment including but not limited to variable frequency drives, and starters.

5. Chart form indicating frequency and type of routine maintenance for all mechanical equipment. The chart shall also indicate model number of equipment, location and service.

6. Provide sales and authorized service representatives names, address, and phone numbers of all equipment and subcontractors.

7. Provide supplier and subcontractor’s names, address, and phone number.

8. Catalog data of all equipment, valves, etc. shall include wiring diagrams, parts list and assembly drawing.

9. Provide and install in locations as directed by the Owner, valve charts including valve tag number, valve type, valve model number, valve manufacturer, style, service and location. Each valve chart shall be enclosed in a durable polymer based frame with a cover safety glass.

10. Copy of the approved balancing report including duct leakage data.

11. ATC systems including as-built ATC drawings of systems including internal of all panels.

12. Access panel charts with index illustrating the location and purpose of access panels.

13. Approved Electrical Certificates.

14. Start-up reports for equipment.

15. Water treatment test reports.

16. Provide and install in locations as directed by Owner, filter charts, including filter type, size, model number, manufacturer, quantity and size for each filter utilized on the project. Filter charts shall be enclosed in a durable polymer based frame with a cover safety glass.

17. Insert color graphic with embedded parameters for ATC system into record and information booklet.

18. Documentation of strainer pulling and cleaning.

D. Submit Record and Information Booklets prior to anticipated date of substantial completion for Engineer review and approval. Substantial completion requires that Record and Information booklets be reviewed and approved.

3.16. INSTALLATION AND COORDINATION DRAWINGS

A. Prepare, submit, and use composite installation and coordination drawings to assure proper coordination and installation of work. Drawings shall include, but not be limited, to the following:

1. Complete Ductwork, Plumbing, Sprinkler and HVAC Piping Drawings showing coordination with lights, electrical equipment, HVAC equipment and structural amenities.

B. Draw plans to a scale not less than 3/8-inch equals one foot. Include plans, sections, and elevations of proposed work, showing all equipment, piping and ductwork in areas involved. Fully dimension all work including lighting fixtures, conduits, pullboxes, panelboards, and other electrical work, walls, doors, ceilings, columns, beams, joists and other architectural and structural work.

C. Identify all equipment and devices on wiring diagrams and schematics. Where field connections are shown to factory-wired terminals, include manufacturer’s literature showing internal wiring.

D. Refer to Division 01 Section 01 31 00 “Project Management and Coordination” for additional requirements related to coordination drawings.

3.17. PIPING SYSTEMS TESTING

A. The entire new HVAC piping systems shall be tested hydrostatically before insulation covering is applied and proven tight under the following gauge pressures for a duration of four (4) hours. Testing to be witnessed by Owner's representative and documented in writing.

SYSTEM	TEST PRESSURE
Condenser Water Supply & Return Piping	100 psi
Dual Temp Supply & Return Piping	100 psi

B. Ductwork pressure testing shall be as specified in another division of these specifications.

C. Testing and acceptance thereof shall be in accordance with local requirements and shall meet approval of authority having jurisdiction. Submit certificates and approved permits and insert one (1) copy in the Operations and Maintenance Manuals.

3.18. EQUIPMENT BY OTHERS

A. This Contractor shall make all system connections required to equipment furnished and installed under other divisions or furnished by the Owner. Connections shall be complete in all respects to render this equipment functional to its fullest intent.

B. It shall be the responsibility of the supplier of this equipment to furnish complete instructions for connections. Failure to do so will not relieve this contractor of any responsibility for improper equipment operation.

3.19. ADDITIONAL FILTERS AND BELTS

A. One complete set of additional filters and belts shall be turned over to the owner upon final acceptance of the building by the owner. Provide correspondence to the Engineer (copy) documenting that additional filters and belts have been turned over to Owner.

B. All filters and belts shall be tagged and identified for equipment served. Furnish filters in protection wrap.

3.20. PHASING

A. Refer to Division 01 Specifications and Contract Drawings for any required phasing.

B. Maintain building egress and traffic ways at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and Authorities having jurisdiction.

C. Provide dust barriers/partitions, penetration closures, etc, to ensure safety of building occupants and protection of existing surroundings.

D. The Building shall remain watertight at all times.

E. Provide necessary piping, valves, drips, piping, conduit, controllers, ATC wiring, etc. as required. Drain and refill piping systems as often as necessary to accommodate phasing and to minimize time length of outages. Temporarily feed new systems with existing system where required or shown on contract drawings.

F. At completion of the first phase the ATC System shall be sufficiently complete to turn over HVAC equipment. All wiring, testing, balancing, commissioning, programming, graphics, and ATC computer shall be completed and operational for all equipment in each phase prior to Owner taking ownership of the same.

G. Within thirty days of Award of Contract, the Contractor shall submit a minimum of six (6) copies of the proposed Phasing Plan (Drawings and detailed written description) to the Engineer and the Owner for review and approval based on the general and specific requirements indicated on the Drawings and Specifications. The phasing plan shall reflect the work of all trades. The phasing plan shall be updated as often as needed (i.e. major deviations and/or modified sequence of events) and reviewed during each progress meeting so the facility, Engineer and Owner can be aware of the areas of construction and progress as it relates to the approved schedule.

H. While work is in progress, except for designated short intervals during which connections are made, continuity of service shall be maintained to all existing systems. Interruptions shall be coordinated with the Owner as to time and duration. The contractor shall be responsible for any interruptions to service and shall repair any damages to existing systems caused by his operations.

3.21. STRAINER CLEANING

A. All equipment strainers must be pulled and cleaned at substantial completion. Document in writing and via digital photographs that all strainers have been pulled and cleaned.

B. Six (6) months after project substantial completion all strainers shall be pulled again and cleaned. Document in writing and via digital photographs that all strainers were pulled and clean at the one year after project substantial completion data.

C. Insert documentation that the strainers have been pulled and cleaned in the Record and Information Books.

D. Re-purge hydronic systems of all air after strainers are pulled and cleaned.

3.22. OUTAGES

A. Provide a minimum of seven (7) days notice to schedule outages. The Contractor shall include in their bid outages and/or work in occupied areas to occur on weekends, holidays, or at night. Coordinate and get approval of all outages with the Owner.

B. Submit Outage Request form, attached at end of this Section, to Owner for approval.

END OF SECTION

OUTAGE REQUEST

DATE APPLIED: _____ BY: _____

DATE FOR OUTAGE: _____ FIRM: _____

START OUTAGE-TIME: _____ DATE: _____

END OUTAGE -- TIME: _____ DATE: _____

AREAS AND ROOMS: _____

FLOOR(S): _____

AREA(S): _____

ROOM(S): _____

WORK TO BE PERFORMED: _____

SYSTEM(S): _____

REQUEST APPROVED BY: _____

(FOREMAN OR OTHER PERSON IN CHARGE)

(FOR OWNER'S USE ONLY):

APPROVED: _____

YES ____ NO ___ BY: _____ DATE: _____

DATE/TIME-AS REQUESTED: _____ OTHER : _____

OWNER'S PRESENCE REQUIRED: _____

YES: ____ NO: ___ NAME: _____

POINT OF CONTACT: _____ PHONE: _____

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SECTION 23 05 05
HVAC PIPING, FITTINGS, AND VALVES

PART 1. GENERAL

1.1. SUMMARY

A. The conditions of the contract and other general requirements apply to the work specified in this section. All work under this section shall also be subject to the requirements of Division 23 Section 23 05 00 Common Work Results for HVAC and Division 01, General Requirements.

B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2. SYSTEM DESCRIPTION CONDITIONS

A. Provide all labor and materials necessary to furnish and install all piping systems on this project as herein specified and/or shown on the drawings. Final connections to equipment furnished in other sections of the specifications shall be included under this section.

B. All piping and insulation installed in ceiling plenums must be plenum rated and comply with NFPA and International Building Code (IBC).

C. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

D. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

E. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.

F. Provide pipe hangers and supports in accordance with ASTM B31.9 and MSS SP69 unless indicated otherwise.

G. Use spring loaded "silent" check valves on discharge of all pumps.

H. Use 3/4 inch (20 mm) ball valves with cap and chain for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

I. At all runout piping serving equipment, use swing joints with elbows to prevent excessive movement of piping due to expansion.

1.3. QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor

regulation. Provide certificate of compliance from authority having jurisdiction indicating approval of welders.

C. Welders Certification: In accordance with ASME Section 9.

D. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

1. All castings used for coupling housings, fittings, and valve bodies shall be date stamped for quality assurance and traceability.

E. Maintain one copy of each document on site.

1.4. DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site under as hereinbefore specified.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed systems.

1.5. EXTRA MATERIALS

A. Provide one (1) repacking kit for each size valve.

1.6. ALTERNATES

A. Refer to Division 01 Section 01 23 00 “Alternates” for description of work under this section affected by alternates.

PART 2. PRODUCTS

2.1. PIPE MATERIALS

A. All materials, unless otherwise specified, shall be new and of the best quality of their respective kinds, and shall conform to the requirements and ordinances of local, state and insurance authorities having jurisdiction.

1. Chilled Water Supply and Return Piping, Chemical Treatment Piping, and Condenser Water Piping (Inside of Building):

a. Pipe: Schedule 40 Black steel pipe, ASTM A53 for dual temperature air chilled water piping and galvanized schedule 80 pipe for the condenser water piping.
1-1/2 inch and smaller - Type F, ASTM A53 steel (CW) with threaded

joints
2 inch and larger - Grade B, Type E, ASTM A53 steel (ERW) with welded, flanged or grooved joints.

b. Fittings & Joints: 2-1/2 inches & larger, schedule 40 wrought steel ASTM A234 Grade WPB or Std. B16.9 long radius welding; factory-fabricated from ASTM A53 pipe; or ASTM A536 ductile iron; 2 inches & smaller 125 lb. std. cast iron screwed, ASTM Standard B16.4; or Vic-Press precision, cold drawn, stainless steel with elastomer O-ring seals. Joints shall be threaded or AWS D1.1 welded. Victaulic, Appollo/Shurjoint, or approved equal grooved joints shall be acceptable.

c. Flanges: Wrought steel Class 150 welding neck. ASTM Standard B16.5.

d. Grooved Joint Couplings: Two ductile iron housings, pressure responsive elastomer gasket, and ASTM A449 zinc electroplated steel bolts and nuts. Couplings shall comply with ASTM F1476 Standard Specification for the Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

i. Rigid Type: Coupling housings shall be cast with offsetting, angle-pattern bolt pads to provide joint rigidity and support and hanging in accordance with ASNI B31.1 and B31.9.

1) Victaulic Style 107H, Apollo/Shurjoint Z-07, Installation-Ready or approved equal, for direct stab installation without field disassembly, with grade EHP gasket, suitable for water service to +250 degrees F.

ii. Flexible Type: For use in locations where vibration attenuation and stress relief are required, and for the elimination of flexible connectors. Victaulic Installation-Ready Style 177 or Style 77, or approved equal.

iii. 14” and Larger: AGS Series, two segment coupling with lead-in chamfer on housing key and wide width FlushSeal gasket. Victaulic Style W07 (rigid) and Style W77 (flexible), Apollo/Shurjoint 7707/7707N, or approved equal.

iv. Flange adapters shall be suitable for direct connection to ANSI Class 125 or 150 flanged components. Victaulic Style 741/W741, Apollo/Shurjoint 7041, or approved equal.

v. Rolled form grooves only. Cut grooves are prohibited.

vi. Verify gasket compatibility on Chemical Treatment piping.

e. Gate Valves: 2-1/2 inches & larger - IBBM, 150 lb. OS&Y grooved end or flanged; 2 inches & smaller - 150 lb. Bronze body bronze trim. Basis of Design: Victaulic Series 771V or approved equal.
For valves 4 inch and larger located in mechanical equipment spaces 10 feet-0 inch or greater above finished floor, valve shall have chain wheel operators with chains extending to within 6 feet-0 inch above finished floor. Chain wheels and guides shall be galvanized.

f. Ball Valves: Shut-off valves 2 inches and smaller shall be ball valves. Ball valves shall be 600cwp, 150swp full port, with RPTFE seats, chrome plated ball and stem 2 ½ and larger, class 125 cast iron OS&Y IBBM gate valve, brass or bronze body, standard port, 2 piece body. Ball valves shall be VicPress end, threaded end or solder end as required to accommodate piping. Ball valves shall be as manufactured by Victaulic, Crane, Apollo, Nibco, Watts or engineer approved equal.

g. Globe Valves: 2-1/2 inches & larger – IBBM 125 lb.std. flanged, with

No. 1 disc; 2 inches & smaller - bronze 150 lb. std. screw ends, with #1 disc.

h. Check Valves: 2-1/2 inches & larger – IBBM or stainless steel trim, 125 lb.std. grooved end or flanged spring-assisted swing check suitable for vertical or horizontal installation, with metal disc; 2 inch & smaller - 125 lb. std. screwed. Provide "silent" spring loaded check valves at all pump discharges. Victaulic Series 716/W715 or approved equal.

i. Balancing Valves: Victaulic Series 377/365, DeZurik Series 100, Fig. 118 or approved equal, ductile iron or cast iron construction, stainless steel bearings, nickel seats (3 inches and larger) non-lubricated, eccentric plug with EPDM, chlorobutyl rubber or Bunz-N resilient faced plugs suitable for 230 degrees F, semi-steel screwed with fig. 159, removable lever and open. nut for valves 3 inches and smaller. For valves 4-inch and larger, provide gear operators and grooved ends or flanged connections. Provide chain operated valves for sizes 4-inches and larger located 10 feet-0 inches or more above finished floor. Chains shall extend to within 6 inch-0 inches above finished floor. All valves shall have adjustable memory stop. Chain wheel and guide shall be galvanized.

j. Butterfly Valves: Victaulic Vic300 MasterSeal/ AGS-Vic300, DeZurik, Apollo 215L series, high performance or Keystone K-Loc, type with infinite position lever (for 3-inches and smaller) and pressure-responsive seat or double seat type and memory stop. Provide gear operator on valves 4-inches and larger.

   i. Valve stem shall be stainless steel, and shall be offset from the disc centerline to provide complete 360 degree circumferential seating.
   ii. Valve shall be rated to +250 deg F in sizes through 12-inches.
   iii. Seat shall be elastomer, of a grade suitable for the intended service. The seat shall be pressure responsive in sizes through 12 inches.
   iv. For valves 4 inches and larger located 10 feet-0 inches or more above finished floor shall be provided with chain operators with chains extending to within 6 feet-0 inches above finished floor. Chain wheel and guide shall be galvanized.

k. Combination Shut-off/Balancing Valves:
Victaulic/ TA Hydronics, Taco Circuit Setter, Bell & Gossett Circuit Setter Plus, Flowset Accuset, Gerand, or as approved equal, 2-inch-3-inch 300 lb. rated Ametal (copper-alloy) body globe type or ball valve with bronze body/brass ball construction with glass and carbon filled TFE seats, in-line flow meter and balancing and shut-off valve with built in ball valve for flow adjustment. Valve shall have memory stop, calibrated nameplate, Schrader valve connections and preformed molded insulation. Valves shall be leaktight at full rated working pressure. Balance valve size shall be selected based on manufacturer’s acceptable flow range and design flow rate. Pressure drop through combination shut off balance valves shall not exceed 5 feet of head at design flow rate.

l. Extended Valve Stems: Provide and install round collar type extended valve stems on all valves installed in insulated piping. Valve stem and collar shall be selected to suit insulation thickness and maintain valve handles outside of insulation.

m. Alternate:

i. At contractors option all HVAC water supply and return lines may be copper type L (ASTM Std. B88) with wrought copper fittings (ASTM Std. B 16.22) with brazed or 95-5 silver solder joints lead and antimony based solders are prohibited and all bronze valves may be used on piping 2 inches and less in size.

ii. At Contractors option, Viega Pro Press/ Mega Press, or Apollo Press/Apollo Power Press, Pressure Seal mechanical fittings may be utilized. Viega, ProPress Pressure Seal Fittings: Bronze or copper shall conform to ASME B16.51, ICC LC 1002, and IAPMO PS 117. ProPress fittings ½-inch thru 4- inch for use with ASTM B88 copper tube type L and ½-inch up to 1-1/4-inch annealed copper tube. ProPress fittings shall have an EPDM sealing element and Smart Connect (SC) feature. 2-1/2-inch thru 4-inch shall have a 420 stainless steel grip ring, PBT separator ring, EPDM sealing element and Smart Connect (SC) feature.

2. Refrigeration Piping: Refrigerant Monitoring Piping

a. Concealed: Tube Size ¾ -inch & Smaller:
ASTM B280, copper tube; Type ACR, soft annealed temper fittings; cast copper-alloy fittings for flared copper tubes; flared joints. Fittings shall be ASME B16.22, wrought copper. Joints shall be brazed, AWS A5.8, BCUP silver/phosphorous/copper alloy with melting range 1190 to 1480 degrees F.

b. Concealed: Tube Size 7/8 inch through 4-1/8inches:
Copper tube, Type ACR, soft annealed temper; wrought-copper, brazed-joint fittings; brazed joints.

c. Exposed: Tube Size ¾ Inch and Smaller:
Copper pipe, Type ASTM B88, Type K with brazed wrought-copper fittings conforming to ASME B16.22. Filler metal shall be brazing type conform to AWS A5.8.

d. Exposed: Tube Sizes 7/8 Inch and Larger:
Copper pipe, Type ASTM B88, Type K with brazed wrought-copper fittings conforming to ASME B16-22. Filler metal shall be brazing type conforming to AWS A5.8.

e. Brazed Joints: Braze joints using American Welding Society (AWS) classification BCuP-4 for brazing filler metal.

f. Flexible connectors: 500-psig (3450-kPa) minimum operating pressure; stainless-steel core and high-tensile stainless-steel-braid covering; dehydrated, pressure tested, minimum 7 inches (180 mm) long.

g. Check Valves: Smaller than NPS 1 (DN 25): 400-psig (2760-kPa) operating pressure and 285 degrees Fahrenheit (141 deg Celsius) operating temperature; cast-brass body, with removable piston, polytetrafluoroethylene seat, and stainless-steel spring; globe design. Valve shall be straight-through pattern, with brazed-end connections.

h. Check Valves: NPS 1 (DN 25) and Larger: 400-psig (2760-kPa) operating pressure and 285 degrees Fahrenheit (141 deg Celsius) operating temperature; cast-bronze body, with cast-bronze or forged-brass bolted bonnet; floating piston with mechanically retained polytetrafluoroethylene seat disc. Valve shall be straight-through or angle pattern, with solder-end connections.

i. Pressure Relief Valves: Straight-through or angle pattern, brass body and disc, neoprene seat, and factory sealed and ASME labeled for standard pressure setting.

B. Steel pipe shall be similar and equal to National Tube Company, Grinnell, Republic, or Bethlehem black or zinc-coated (galvanized) as hereinafter specified. Pipe shall be free from all defects which may affect the durability for the intended use. Each length of pipe shall be stamped with the manufacturer's name.

C. Copper pipe shall be Revere, Anaconda or Chase with approved solder fittings.

D. Welding fittings for steel pipe shall meet the requirements of ASTM Standard A-23 and shall be standard catalog products. Fittings fabricated by metering and notching pipe will not be accepted.

2.2. PIPE HANGERS, ROLLER SUPPORTS, ANCHORS, GUIDES, AND SADDLES

A. All hangers for metallic piping shall be adjustable, wrought clevis type, or adjustable malleable split ring swivel type, having rods with machine threads. Hangers shall be Grinnell Company's Figure 260 for pipe ¾-inch and larger, and Figure 65 for pipe 2-inches and smaller, or approved equal. Adjustable pipe stanchion with U-bolt shall be Grinnell Company's Figure 191. Pipe roller supports shall be Grinnell's Figure 181 or Figure 271. Exterior pipe hangers shall be galvanized or stainless steel construction. For copper piping in direct contact with the hanger, hanger construction shall be copper coated to prevent contact of dissimilar metals similar to Grinnell's Figure CT-65. Hanger spacing and rod sizes for steel and copper pipe shall not be less than the following:

NOMINAL PIPE SIZE IN	STD. STEEL PIPE	MAXIMUM SPAN FT. COPPER TUBE	MINIMUM ROD DIAMETER INCHES OF ASTM A36 STEEL THREADED RODS
3/4 & 1	6	5	3/8
1 - ½	6	8	3/8
2	8	8	3/8

NOMINAL PIPE SIZE IN	STD. STEEL PIPE	MAXIMUM SPAN FT. COPPER TUBE	MINIMUM ROD DIAMETER INCHES OF ASTM A36 STEEL THREADED RODS
2 – ½	10	9	½
3	12	10	½
4	14	12	5/8
5	14	12	5/8
6	16	14	3/4
8	18	16	7/8
10	20	18	7/8
12	20	18	7/8

B. Anchors, guides, and roller supports shall be installed in accordance with the contract drawings and manufacturer's recommendations to provide pipe support and control pipe movement for all piping systems. Anchors and guides shall be securely attached to the pipe support structure. Submit shop drawing for proposed pipe support structure for guides and anchors for approval of the Structural Engineer. Pipe alignment guides shall be Fig. 255 Grinnell, or as approved equal. Guides shall be sized to accommodate the pipe with insulation. Guides shall be steel factory, fabricated, with bolted two section outer cylinder and base for alignment of piping and two section guiding spider for bolting to pipe.

C. Hangers for pipe sizes ½ to 1 ½ inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring.

D. Hangers for cold pipe sizes 2 inches (50 mm) and over: Carbon steel, adjustable, clevis.

E. Hangers for cold pipe sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis.

F. Hangers for cold pipe sizes 6 inches (150 mm) and over: adjustable steel yoke, cast iron roll, double hanger.

G. Multiple or Trapeze hangers: Steel channels with welded spacers and hanger rods.

H. Multiple or Trapeze hangers for hot pipe sizes 6 inches (150 mm) and over: Steel channels with welded spacers and hanger rod, cast iron roll.

I. Wall support for pipe sizes to 3 inches (76 mm): cast iron hook

J. Wall support for pipe sizes 4 inches (100 mm) and over: Welded steel bracket and wrought steel clamp.

K. Wall support for hot pipe sizes 6 inches (150 mm) and over: welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.

L. Vertical Support: Steel riser clamp.

M. Floor support for cold pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

N. Floor support for hot pipe sizes to 4 inches (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

O. Floor support for hot pipe sizes 6 inches (150 mm) and over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

P. Copper pipe support: Carbon steel ring, adjustable, copper plated.

Q. Hanger rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

R. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

S. For exterior pipe supports provide stainless steel brackets and anchors.

2.3. VALVES

A. Provide parts list and assembly drawings (exploded view) for all valves in shop drawing submittals. Provide valves of the same type by the same manufacturer.

B. Check valves in base mounted pump discharges shall be of the vertical type and shall be Victaulic Series 716/ W715, Miller "non-slam" check valves, Apollo/Shurjoint SJ-900, or approved equal suitable for service intended. Check valves in circulator discharges shall

be horizontal type.

C. Provide at each base mounted pump a suction diffuser of size and type shown on drawings. Units shall consist of a ductile cast iron angle type body with inlet vanes, magnetic insert, and blowdown connection tapped gauge post, 125 psi ANSI flange and a combination stainless steel diffuser strainer with 5/32 or 3/16-inch diameter opening for pump protection. Unit shall be equipped with a disposable fine 20-mesh stainless steel start up strainer which shall be removable after 30 days. Flow direction shall be from inside the strainer to outside for ease of service and cleaning. The body shall fit the pump and connecting pipe size. The unit shall be provided with a base support boss or an adjustable support foot to relieve piping strains from the pump suction. Suction diffuser shall be Victaulic 731 Series, Taco "SD" Series Catalog 300-4.1, Bell and Gossett Model FLG, Armstrong, Patterson, Apollo/Shurjoint 725F, or engineer approved equal.

D. Multi-purpose valve (non-slam check valve, throttling valve, shut-off valves and calibrated balancing valve) shall be provided at discharge side of constant speed pumps. The valve shall be of heavy-duty cast iron construction with standard ANSI flanged connections and rated for a maximum working pressure of 175 psig at 240oF. The valve shall be fitted with a stainless steel stem or stem sleeve and brass seat with "O" ring seal. Valve shall be Taco "Plus One" Number 300-4.2, Bell and Gossett 3DS Triple Duty Valve, Armstrong, Patterson, or as approved equal, and shall have check and plug valve features plus a memory stop with pointer and scale. Provide additional shut-off valve to allow servicing of check valve if a multipurpose valve is utilized in lieu of separate check, shut-off, and balance valve. Provide additional shut-off valve downstream of multi-purpose valve to allow servicing of multi-purpose check valve feature. Provide pre-manufactured, removable insulation covers for all multipurpose valves.

E. Triple Duty Valve Assembly: Assembly shall consist of a Victaulic Master Seal, Apollo/Shurjoint SJ-900, or approved equal butterfly valve with memory stop and a Series 779 Venturi-Check, rated for water service to 230 degrees Fahrenheit (110 degrees Celsius) and pressures to 300 psig (2065-kPa).

1. For 14” through 24” sizes, Victaulic AGS-Vic300, Apollo/Shurjoint SJ-300N-L/SJ-300N-W, or approved equal butterfly valve with Series W715 AGS check valve, rated for pressures to 230 psig (1575-kPa).

2.4. STRAINERS

A. Strainers shall be of the basket or "Y" type and shall be heavy and durable, constructed of ductile iron to ASTM A536 or the best grade gray iron with the bottoms drilled and plugged. Bodies shall have arrows clearly cast on the sides to show flow direction. Strainers shall be equipped with easily removable covers and brass sediment baskets made of stainless steel or brass not less than #22 gauge in thickness. Total area of basket perforations shall be not less than two times the cross section of the entering pipe. Flow shall be into basket, and then out through the perforations. Strainers shall be suitable for water or the intended fluid. Strainers 2 inches and smaller shall have threaded or solder ends, 2 inches and larger shall have flanged ends.

B. Strainer screens shall be stainless steel with perforations and shall be 1/16-inch for pipe sizes 5 inches and less, 1/8-inch (40 percent open area) perforations for pipe sizes 6-inch and greater.

C. Provide valved and capped (with chain) blowdowns in each strainer. Blowdown valves shall be Apollo 78-100/200 series or as approved equal.

D. Strainers shall be manufactured by Victaulic Style 732/W732, Watts, Mueller, Armstrong, Yarway, Spirax/Sarco, Apollo/Shurjoint 726, or as approved equal.

2.5. UNIONS, FLANGES, AND COUPLINGS

A. Unions in steel pipe 2-inches and smaller shall be malleable iron with brass inserted seats designed for a working pressure of 150 psig.

B. Unions in copper pipe 2-inches and smaller shall be sweat fittings with bronze seats designed for a working pressure of 125 psig.

C. Unions in stainless steel pipe 2-inches and smaller shall be hexagonal threaded type stainless steel unions, with VicPress ends. Basis of Design: Victaulic Style P584.

D. Flanges for steel pipe over 2 inches shall be 150 psig, forged steel, slip on. Gaskets shall be 1/16 inch thick pre-formed neoprene.

E. Flanges for copper pipe over 2 inches shall be bronze. Gaskets shall be 1/16 inch thick preformed neoprene.

2.6. MANUAL AIR VENTS

A. Manual air vents shall be similar to the hereinafter specified gauge valves. Provide 1/4-inch size on ¾-inch pipe and smaller, ½ -inch size on 1-inch pipe and larger. Install at all high points of piping. Valves shall be Crane No. 88, or as approved equal, with threaded ends, bronze body, bronze or brass bonnet and bronze stem.

2.7. AUTOMATIC AIR VENTS

A. Provide where shown on the drawings, float actuated non-modulating high capacity air vent to purge free air from the system and provide a positive shut-off at pressures up to 150 psig at a maximum temperature of 250 degrees Fahrenheit. The high capacity air vent shall prevent air from entering the system if the system pressure drops below atmospheric pressure. The air vent shall be pilot operated for intermittent purging of free air up to pressures of 2 psig during normal system operation and diaphragm operated for full capacity purging of free air at pressures between 2 and 150 psig. The high capacity air vent shall be constructed of cast iron and fitted with components of type 313 stainless steel, brass, EPDM and silicone rubber. Pipe discharge to closest floor drains with Type K copper tubing. The high capacity vent shall be Model 107 by Bell and Gossett, Model 13w by Spirax Sarco, Taco, Spirotherm Spirotop, or as approved equal.

2.8. THERMOMETERS

A. Unless otherwise indicated, thermometers shall be ASTM E1, in a glass type, organic filled, 9-inch scale size, corrosion-resistant metal case, with "any-angle" mounting with positive locking device. Trerice Industrial Thermometers, Weksler Instruments, Ernst Gage Co., Miljoco, or approved equal. Insertion stem length shall suite the pipe size and configuration. Thermometer wells shall be brass with brass union hubs in copper and in

ferrous piping. Where piping is insulated or otherwise covered, use wells with lagging extension. Where wells are installed in pipe tees at turns, increase pipe size so that well does not restrict flow. Accuracy shall be 2 percent.

B. Unless otherwise indicated, thermometer ranges shall be as follows:

1. Chilled water systems: 0 degrees F to 100 degrees Fahrenheit, 1 degrees Fahrenheit Division

2. Dual Temperature: 30 degrees Fahrenheit to 240 degrees Fahrenheit, 2 degrees Fahrenheit Division.

3. Condenser water: 30 degrees Fahrenheit to 240 degrees Fahrenheit, 2 degrees Fahrenheit Division.

C. Provide heat conducting compound in wells.

2.9. PRESSURE GAUGES

A. Unless otherwise indicated, pressure gauges shall be the bronze bourdon tube type, 4-1/2-inch dial, stem mounting, cast aluminum adjustable pointer, 1 percent accuracy over middle half of scale range, 1-1/2 percent over balance: Trerice Model 600C; Weksler Instruments, Ernst Gage Co., Miljoco, or as approved equal.

B. Gauges shall have pressure, vacuum, compound, or retard ranges as required, select ranges so that the normal readings are at the approximate midpoint and maximum system pressures do not exceed full scale.

C. Furnish and install a gauge valve at each pressure gauge. Gauge valves shall be Crane Model No. 88, Needle Valve, Ernst Gage Co. FLG 200, Wexler Instrument Corp. Type BBV4, or approved equal, rated for pressure intended.

D. Gauge connections for pressure gauges, thermometers, or control instruments shall be made using tee fittings, except that gauge connections up to 1-inch size in steel may be using threaded extra heavy pipe couplings welded directly to the main, provided that the main is at least 2-inch size for 2-inch connections, 3-inch size for 3/4-inch connections, and 4-inch size for 1-inch connections. Minimum gauge connection shall be 2-inch ips.

E. Provide snubbers on all gauges. Snubbers shall be No. 872 by Trerice, RS1/RS6 by Wexler Instruments, Miljoco or as approved equal.

2.10. FLOW METERS

A. Griswold or Bell & Gossett Venturi disturbed flow measurement quickset flow meters shall be utilized in lieu of sentinel type flow meters. Units shall consist of a spun steel venturi welded into the pipe. Disturbed fluid shall be channeled through the throat of the venturi with a multi-point Piezo Ring. Accuracy shall be ± 1% PSID with no straight pipe run required. Furnish differential pressure gauge supplied with carrying case and hoses.

2.11. PIPING SPECIALTIES

A. Furnish and install flexible pipe connections, as specified and/or shown on the drawings, at suction and discharge connections of all base mounted pumps, all vibrating equipment, and elsewhere as shown. Pump flexible connections shall be utilized at pumps. Refer to Division 23 Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment" for specifications.

2.12. ESCUTCHEONS

A. Provide chromium plated escutcheons properly fitted and secured with set screws on all exposed piping which passes through walls, floors or ceilings of finished spaces.

B. All escutcheon plates shall be chrome plated spun brass of plain pattern, and shall be set tight on the pipe and to the building surface. Plastic escutcheon plates will not be accepted.

2.13. DIELECTRIC CONNECTIONS:

A. Furnish and install electrically insulated dielectric waterway fittings, unions or flanges, as manufactured by Victaulic Company Style 47, EPCO Sales, Inc., or approved equal at the following locations:

1. Where steel piping systems join copper piping.

2. Where copper tube connects to domestic water storage tanks, water heaters, heat exchangers, expansion tanks, and other steel vessels.

3. Avoid the installation of steel nipples, cast iron or steel valves and specialties, or other ferrous components in predominately copper piping systems. Where such installation is necessary, isolate the component with dielectric connections. Do not mix steel pipe and copper tube in the same run of pipe or in the same section of a piping system.

4. Dielectric Waterway: Copper silicon casting conforming to UNS C87850 with grooved and/or threaded ends. UL classified in accordance with NSF-61 for potable water service, and shall meet the low-lead requirements of NSF-372. Basis of Design: Victaulic Series 647.

2.14. SLEEVES

A. Sleeves shall be provided around all pipes through walls, floors, ceilings, partitions, or other building parts. Sleeves shall be standard weight galvanized iron pipe two sizes larger than the pipe or insulation so that pipe or insulation shall pass through masonry or concrete walls or floors. Provide 20 gauge galvanized steel sheet or galvanized pipe sleeves for all piping passing through frame walls.

B. Sleeves through floors shall be flush with the floor except for sleeves passing through Equipment Rooms which shall extend ¾-inch above the floor. Refer to Division 23 Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment" for mechanical equipment room penetrations additional requirements. Space between the pipe and sleeve shall be caulked. Escutcheon plates shall be constructed to conceal the ends of sleeves. Each trade shall be responsible for drilling existing floors and walls for necessary sleeve holes. Drilling methods and tools shall be as hereinbefore specified.

C. Sleeves through walls and floors shall be sealed with a waterproof caulking compound.

D. Firestop at sleeves that penetrate smoke barriers smoke partitions and/or rated walls/floors.

2.15. WATER PROOF PIPE PENETRATION SEALS

A. Provide and install waterproof pipe penetration seals at all pipes that enter the building below grade or through exterior wall.

B. Link seals are to be Metraflex Metraseals, Model MS, Linkseal, or approved equal, black EPDM seal material, glass reinforced plastic pressure plates, zinc plated nuts and bolts, seals are to be resistant to sunlight and ozone, pressure rated to make a hydrostatic seal of up to 20 psig and up to 40 feet of head, temperature rated from –40 degrees F to 250 degrees Fahrenheit.

2.16. TEST PLUGS

A. Where indicated, furnish and install P/T plugs or Pete's Plugs as manufactured by IMAC Systems or approved equal.

B. Description: Nickel-plated, brass-body test plug in NPS 2 (DN15) fitting. Test plugs shall be as manufactured by Trerice, Watts, Natural Meter, Apollo Brass Test Plugs, or approved equal. Test-station fitting made for insertion in piping tee fitting.

C. Body: Length as required to extend beyond insulation. 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 ¼ (DN 8) or NPS ½ (DN15) as required, ASME B1.20.1 pipe thread.

E. Pressure Rating: 500 psig minimum.

F. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

G. Core Inserts: One or two self-sealing valves, suitable for inserting 1/8 inch OD probe from dial-type thermometer or pressure gage. Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

H. Core Insert: Self-sealing valve, suitable for inserting 1/8 inch OD probe from dial-type thermometer or pressure gage.

I. Core Material for Air, Water, Oil, and Gas: 20 to 300 degrees F chlorosulfonated polyethylene synthetic rubber.

J. Test-Plug Cap: Gasketed and threaded cap, with retention chain or strap.

K. Pressure Gage and Thermometer Ranges: approximately two times the system's operating conditions.

L. Self-closing valves with caps and retaining straps.

PART 3. EXECUTION

3.1. GENERAL PIPING INSTALLATION REQUIREMENTS

A. All pipes shall be cut accurately to measurements established at the building, and shall be worked into place without springing or forcing, properly clearing all windows, doors and other openings. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted. All pipes shall be so installed as to permit free expansion and contraction without causing damage. All horizontal mains shall pitch down in the direction of flow with a grade of not less than 1 inch in 40 feet. All open ends of pipe lines, equipment, etc., shall be properly capped or plugged during installation to keep dirt or other foreign material out of the system. All pipes shall be run parallel with the lines of the building and as close to walls, columns and ceilings as may be practical, with proper pitch. All piping shall be arranged so as not to interfere with removal of other equipment on devices not to block access to doors, windows, manholes, or other access openings. Flanges or unions, as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment, coils, etc., and installed so that there will be no interference with the installation of the equipment, ducts, etc. All valves and specialties shall be placed to permit easy operation and access and all valves shall be regulated, packed and glands adjusted at the completion of the work before final acceptance. All piping shall be installed so as to avoid air or liquid pockets throughout the work. Ends of pipe shall be reamed so as to remove all burrs.

B. All piping shall be graded to convey entrained air to high points where automatic air vents shall be provided. The size of supply and return pipes for each piece of equipment shall in no case be smaller than the outlets in the equipment.

C. All piping shall be run to provide a minimum clearance of 2-inches between finished covering on such piping and all adjacent work. Group piping wherever practical at common elevations.

D. All valves, strainers, caps, and other fittings shall be readily accessible.

E. Drain valves with hose connections shall be provided at low points for drainage of piping systems. Blow down valves shall be provided at the ends of all mains and branches so as to properly clean by blowing down the lines throughout in the direction of normal flow.

F. All branches from water mains shall be taken from the top of the supply mains at an angle of forty-five (45) degrees above the horizontal, unless otherwise directed. Branches feeding down shall be taken from the side or bottom of the main on water mains only. All connections shall be carefully made to insure unrestricted circulation, eliminate air pockets or trapped condensate, and permit the complete drainage of the system.

G. Unions shall be installed on all bypasses, ahead of all traps, at all connections to equipment, where shown on drawings or where required to facilitate removal of equipment whether shown or not.

H. Spring clamp plates (escutcheons) shall be provided where pipes are exposed in the building and run through walls, floors, or ceilings. Plates shall be chrome plated spun brass of plain pattern, and shall be set tight on the pipe and to the building surface.

I. If the size of any piping is not clearly evident in the drawings, the Contractor shall request instructions for the Engineer as to the proper sizing. Any changes resulting from the

Contractor's failure to request clarification shall be at his expense. Where pipe size discrepancies or conflicts exist in the drawings, the larger pipe size shall govern.

J. Install all valves with stem upright or horizontal, not inverted.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, weld and apply one coat of zinc rich primer.

L. Provide clearance for installation of insulation and access to valves and fittings.

M. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

N. All water containing pipes shall be routed clear of combustion air dampers and louvers to prevent freezing condition when dampers are open.

O. Provide manual air vents at top of piping systems.

3.2. THERMOMETER AND PRESSURE GAGE INSTALLATION REQUIREMENTS.

A. Install thermometers and adjust vertical and tilted positions.

B. Install separable sockets in vertical position in piping tees where fixed thermometers are indicated.

1. Install with socket extending to one-third diameter of pipe.

2. Fill sockets with oil or graphite and secure caps.

C. Install pressure gages in piping tees with pressure-gage valve located on a pipe at most readable location.

D. Adjust faces of thermometer and gages to proper angle for best visibility.

E. Clean windows of thermometer and gages and clean factory-finished surfaces. Replace cracked and broken window, and repair scratched and marred surfaces with manufacturer's touch up paint.

3.3. VALVE INSTALLATION REQUIREMENTS

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. 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.

C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

G. Install valves as indicated, according to manufacturer's written instructions.

H. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.

I. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.

J. Locate valves for easy access and provide separate support where necessary.

K. Install valves in horizontal piping with stem at or above the center of the pipe.

L. Install valves in a position to allow full stem movement.

M. For chain wheel operators, extend chains to 60 inches above finished floor elevation.

N. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

3.4. REFRIGERANT PIPING AND ACCESSORIES INSTALLATION REQUIREMENTS

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 Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. 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. All exposed piping shall be hard copper tubing with brazed joints.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to units to allow service and maintenance.

G. Install fittings for changes in direction and branch connections.

H. Select system components with pressure rating equal to or greater than system operating pressure.

I. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

J. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

K. Identify refrigerant piping and valves.

L. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section 23 05 00 “Common Work Results for HVAC”.

M. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section 23 05 00 “Common Work Results for HVAC”.

N. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section 23 05 00 “Common Work Results for HVAC”.

O. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6m) long.

2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6m) or longer.

3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6m) or longer, supported on a trapeze.

4. Spring hangers to support vertical runs.

5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

P. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS ½ (DN 15): Maximum span, 60 inches (1500mm); minimum rod size, ¼ inch (6.4mm).

2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500mm); minimum rod size, ¼ inch (6.4mm).

3. NPS 1 (DN 25): Maximum span, 72 inches (1800mm); minimum rod size, ¼ inch (6.4mm).

4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400mm); minimum rod size, 3/8 inch (9.5mm).

5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400mm); minimum rod size, 3/8 inch (9.5mm).

6. NPS 2 (DN 50): Maximum span, 96 inches (2400mm); minimum rod size, 3/8 inch

(9.5mm).

7. NPS 2-½ (DN 65): Maximum span, 108 inches (2700mm); minimum rod size, 3/8 inch (9.5mm).

8. NPS 3 (DN 80): Maximum span, 10 feet (3m); minimum rod size, 3/8 inch (9.5mm).

9. NPS 4 (DN 100): Maximum span, 12 feet (3.7m); minimum rod size, 1/2 inch (13mm).

Q. All accessories shall be ARI rated. Furnish required nitrogen and refrigerant to fully test and charge system. Flood piping system with nitrogen when brazing.

R. Refrigerant piping shall be Type 1 hard temper (ACR) copper tubing with wrought copper brazed fittings. Make joints with brazed wrought copper fittings.

S. Follow ASHRAE 15, latest edition procedures for charging and purging of systems and for disposal of refrigerant.

T. Refrigerant monitoring piping shall be connected to refrigerant monitoring equipment and piped per the Manufacturer's requirements.

U. Before installing copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene.

3.5. PIPE JOINTS INSTALLATION REQUIREMENTS

A. Welded Joints: Joints in piping 2-1/2-inches and larger shall be fusion welded. Welding shall be in accordance with recommendations of the American Welding Society. Welding fittings shall conform in physical and chemical properties to the latest revisions of the American Society for Testing Materials.

B. Qualify welding procedures, welders and operators in accordance with ASME B31.1, or ASME B31.9 as applicable, for shop and project site welding of piping work. Certify welding of piping work using Standard Procedure Specifications by, and welders tested under supervision of, National Certified Pipe Welding Bureau (NCPWB). Submit welders qualifications for approval.

C. Grooved Joints: Grooved joint shall be installed in accordance with the manufacturer’s written recommendations. Grooved ends shall be clean and free from indentations, projections, or roll marks. The gasket shall be molded and produced by the coupling manufacturer of an elastomer suitable for the intended service. The coupling manufacturer’s factory trained representative shall provide on-site training for the contractor’s field personnel in the use of grooving tools and installation of product. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed. (A distributor’s representative is not considered qualified to conduct the training.)

D. Screwed Joints: All screwed joints shall be made with tapered threads properly cut. Screwed joints shall be made perfectly tight with a stiff mixture of graphite and oil, applied

with a brush to the male threads on the fittings.

E. Soldered Joints and Copper Piping: Joints in copper piping shall conform to the following minimum standards.

1. The pipes shall be cut to a length making certain that the ends are square, using a fins hacksaw blade or tube cutter. The ends of all pipes shall be reamed and all burrs removed.

2. The outside end of the pipe and the cut end of the fitting shall be cleaned with steel wool, sand cloth, or steel wire brush. All dark spots shall be removed.

3. The flux shall be applied evenly and sparingly to the outside end of the pipe and the inside of the outer end of the fitting until all surfaces to be jointed are completely covered. The piping and fitting shall be slipped together and reworked several times to insure an even distribution of the flux.

4. The correct amount of solder per joint for each size pipe shall be used in accordance with the manufacturer's recommendations.

5. Solder joints shall be made by using a direct flame from a torch.

6. On pipe sizes larger than ¼-inch, the fittings and valves in the pipe shall be moved or tapped with a hammer when the solder starts to melt to insure an even distribution of the solder.

7. The excess solder shall be removed while it is still in the plastic state leaving a fillet around the cup of the fitting.

8. Solder joints shall be suitable for working pressure of 100 psig and for working temperature of not less than 250 degrees F. The type of solder and flux used will be submitted for approval. Type 95-5 shall be the minimum standard.

9. Lead and antimony-based solders shall not be used for potable water systems. Brazing and silver solders are acceptable.

F. Where copper piping joins steel piping, approved bronze adapters shall be used.

G. Prohibited Connections: No direct weld, soldered, or brazed connections, without unions or flanges, shall be made to valves, strainers, apparatus, or related equipment. Right and left couplings, long threads, or caulking of pipe threads or gasket joints will not be permitted.

3.6. HANGERS, SUPPORTS, ANCHORS, GUIDES INSTALLATION REQUIREMENTS

A. General: All hangers shall be of an approved type arranged to maintain the required grading and pitching of lines to prevent vibration and to provide for expansion and contraction. Provide protection saddles between hangers and insulation on heating water insulated pipe. Saddles shall be Grinnells Figure 173/273 or approved equal. Provide approved spacers between saddles and pipe where flexible insulation is specified. Provide insulation protection shields for insulated piping without saddles. Shield shall be Grinnell

Figure 167 or as approved equal.

B. Spacing: Regardless of spacing, hangers shall be provided at or near all changes in direction, both vertical and horizontal, for all piping. For cast iron soil pipe, one hanger shall be placed at each hub or bell.

C. Vertical Lines: Shall be supported at their bases, using either a suitable hanger placed in a horizontal line near the riser, or a base type fitting set on a pedestal, foundation or support. All vertical lines extending through more than one floor level shall be supported at each floor with a riser clamp. Riser clamp shall be Grinnell Co.'s Figure 261, or approved equal. All vertical drops to pump suction elbows shall be supported by floor posts.

D. Racks and Brackets: All horizontal piping on vertical walls shall be properly supported by suitable racks securely anchored into the wall construction. Where not practical to obtain ceiling anchorage, all piping near walls shall be supported by approved brackets securely anchored into the wall construction. Washer plates (Fib. 60, 60L) and other miscellaneous attachments, fasteners, etc., shall be Grinnell or as approved equal. All exterior hanger and bracket systems in their entirety shall be galvanized.

E. Pipe Hangers and supports shall be attached to the panel point at the top chord of bar joist or at a location approved by the structural engineer.

F. Select hangers and components for loads imposed. Secure rods with double nuts.

G. Support of horizontal piping shall allow for vertical adjustment after installation of piping.

H. Support overhead piping with clevis hangers.

I. Do not support all parallel piping from the same joist. Stagger all supports in accordance with the engineer's recommendations.

3.7. PIPING IDENTIFICATION INSTALLATION REQUIREMENTS

A. All piping shall be identified with painted background marked with the name of the service with arrows to indicate flow direction. Color code and system identification shall comply with ANSI Standards and piping identification system shall comply with ASME A13.1-81., scheme for the identification of piping systems and ASHRAE Fundamentals Handbook, latest edition.

B. Markings shall be plain block letters, stenciled on pipes, and shall be located near each branch connection, near each valve, and at least every 10 feet on straight runs of pipe. Where pipes are adjacent to each other, markings shall be neatly lined up. All markings shall be located in such manner as to be easily legible from the floor. Pipe identification schedule shall be as follows:

OUTSIDE DIAMETER OF PIPE OR COVERING (INCHES)	LENGTH OF COLOR FIELD (INCHES)	SIZE OF LETTERS (INCHES)

½ to 1 ¼	8	½
1-½ to 2	8	¾
2 ½ to 6	12	1 ¼
8 to 10	24	2 ½
Over 10	32	3 ½

3.8. VALVE IDENTIFICATION REQUIREMENTS

A. All valves shall be tagged with a numbered tag.

B. The tags shall be made of 1-inch diameter brass tags fastened to the valve by means of brass chains. Numbers shall agree with valve numbers on diagrammatic herein before specified.

C. Provide a minimum of six (6) valve charts with valve numbers indicating valve type, size, manufacturer and service.

D. Additional valve charts shall be mounted behind glazed wooden frames and be hung in each mechanical equipment room including each air handling unit mechanical equipment room. Additional copies shall be provided in each copy of the O&M manuals.

3.9. CLEANING PIPING AND EQUIPMENT

A. All dual temperature, condenser water, and chilled water systems shall be cleaned by filling with a solution of one (1) pound of trisodium phosphate to each 50 gallons of water and circulating this solution for a period of six (6) hours during which time the system shall reach operating temperature. The systems shall then be flushed with fresh water and refilled with fresh water and/or where indicated antifreeze solution and purged of all air. Provide temporary bypasses in mechanical room as required for flushing chilled water system. Only chilled water piping in mechanical room where impacted by new work is required to be flushed and cleaned.

B. All condenser water, chilled water, dual temperature, piping system shall be flushed clean with fresh water.

C. Any equipment, such as coils that have small tubing, shall be bypassed to prevent deposition of debris from the piping. Water balancing shall not be scheduled until the completion of the cleaning and treatment process.

D. All strainers shall be inspected and cleaned prior to testing and balancing. In addition, prior to substantial completion, contractor must inspect and clean all strainers.

END OF SECTION

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VIBRATION & SEISMIC CONTROLS FOR HVAC PIPING & EQUIPMENT
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SECTION 23 05 48
VIBRATION & SEISMIC CONTROLS FOR HVAC PIPING & EQUIPMENT

PART 1. RELATED DOCUMENTS

1.1. GENERAL

A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to work of this section.

B. All work under this section shall also be subject to the requirements of Division 23 Section 23 05 00 Common Work Results for HVAC.

1.2. SUMMARY

A. Provide all labor and materials necessary to furnish and install vibration control systems on this project as herein specified and/or shown on the drawings.

B. Mount all mechanical equipment on suitable vibration isolators so as to prevent transmission of vibration into or through the building structure. Isolators shall be as manufactured by Mason Industries, Inc., Korfund, Inc., Amber Booth, Vibration Mounting and Controls, or approved equal, and shall be selected by the isolator manufacturer for each item of equipment in accordance with requirements hereinafter specified.

C. The equipment manufacturer shall supply all pump and motor bases, fan and motor bases, cradles, isolation pipe/duct hangers, spring and/or neoprene isolators, neoprene pads, flexible connectors, etc. as a coordinated package by a single manufacturer.

D. Select isolators for uniform static deflections according to distribution of weight; and for not less than the indicated isolation efficiency with the lowest rotational speed of equipment as the disturbing frequency.

E. Isolators and bases shall be stable during stopping and starting of equipment without transverse or eccentric movement of equipment, and shall be designed to resist horizontal forces of equipment which may operate unbalanced.

F. In general, select isolators on the basis of criteria as specified in the ASHRAE Applications Handbook, Latest Edition.

1.3. SUBMITTALS

A. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each.

B. Product Data: Provide schedule of vibration isolator type with location and load on each.

C. Manufacturer’s Installation Instructions: Indicate special procedures and setting dimensions.

D. Manufacturer’s Certificate: Certify that isolators are properly installed and adjusted to meet or exceed specified requirements.

1.4. PROJECT RECORD DOCUMENTS

A. Record actual locations of hangers including attachment points.

1.5. COLOR CODING

A. All springs shall be color coded for load carrying capacity.

1.6. ALTERNATES

A. Refer to Division 01 Section 01 23 00 “Alternates” for description of work under this section affected by alternates.

PART 2. PRODUCTS

2.1. MANUFACTURER

A. Isolators shall be the equivalent of the following types by Mason Industries, Inc., Korfund, Inc. or approved equal.

2.2. CORROSION PROTECTION FOR STEEL PARTS

A. Where steel parts are exposed to weather or humid environments provide hot-dipped galvanized coating of at least 2 ounces of zinc per square foot of surface. Coat springs with neoprene.

2.3. SPRING MOUNTS AND SOUND PADS

A. Provide all spring mounts with leveling devices, minimum .25 inch thick neoprene sound pads, and zinc chromate plated hardware.

B. All sound pads shall be size for minimum deflection of .05 inch; meet requirements for neoprene pad isolators.

2.4. SPRINGS

A. All springs shall have minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between .3 and .6 of maximum deflection.

2.5. FLOOR MOUNTED ISOLATORS:

A. Neoprene Isolation Pads: Provide pads at least ¼ " thick with cross-ribbed or waffle design. For concentrated loads provide steel bearing plates bonded or cold cemented to the pads. Neoprene isolation pads shall be Type Super W.

B. Neoprene Isolators: Rubber (neoprene)-in-shear mounting: Provide molded neoprene isolators having steel base plates with mounting holes and, at the top, steel mounting plates with mounting holes or threaded inserts. Provide elements of type and size coded with molded letters or color-coded for capacity identification. Embed metal parts completely in neoprene. Double deflection neoprene mountings shall have a minimum static deflection of 0.35". Bolt holes shall be provided for these areas where bolting is required. On equipment such as small vent sets and close coupled pumps, steel rails shall be used above

the mounting to compensate for the over-hang. Mountings shall be type ND or rails type DNR.

2.6. SPRING ISOLATORS

A. General: Provide spring isolators or protected spring isolators that are adjustable and laterally stable with free-standing springs of horizontal stiffness at minimum 80 percent of the vertical (axial) stiffness. For machine-attached and floor-attached restraining elements, separate from metal-to-metal contact by neoprene cushions 1/8 inch thick minimum. Provide neoprene acoustic friction pads at least ¼ inch thick.

B. Spring Isolator: Spring type isolators shall be free standing and laterally stable without any housing and complete with ¼ " neoprene acoustical friction pads between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflections, compressed spring height and solid spring height. Mountings shall be type SLF as manufactured by Mason Industries, Inc. or as approved equal.

2.7. SUSPENSION ISOLATORS

A. General: Provide hangers with suspension isolators encased in open steel brackets. Isolate hanger rods from isolator steel brackets with neoprene-lined opening.

B. Suspension Neoprene Isolators: Provide double-deflection elements with minimum 3/8 inch deflection.

C. Suspension Spring Isolators: Vibration hangers shall contain a steel spring and 0.3" deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing thru a 30o arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing of the hanger showing the 30o capability. Hangers shall be type 30N.

2.8. FLEXIBLE CONNECTORS FOR PIPING

A. General: Straight or elbow flexible connectors rated for temperatures, pressures, and fluids to be conveyed. Provide flexible connectors with the strength 4 times operating pressure at highest system operating temperature. Provide elbow flexible connectors with a permanently set angle.

B. Elastomeric Flexible Connectors: Flexible neoprene connectors shall be manufactured of multiple plys of nylon tire cord fabric and neoprene both molded and cured in hydraulic rubber presses. No steel wire or rings shall be used as pressure reinforcement. Straight connectors shall have two spheres. Connectors up to and including 1 ½ " diameter may have threaded ends. Connectors 2" and larger shall be manufactured with floating galvanized flanges recessed to lock the connector's raised face neoprene flanges. Hoses shall be installed on the equipment side of the shut-off valves. Connectors shall be rated a minimum of 150 psi at 220°F. Flanged equipment shall be directly connected to neoprene elbows in the size range 2 ½ " through 12" if the piping makes a 90° turn at the equipment.

All straight through connections shall be made with twin-spheres properly pre-extended as recommended by the manufacturer to prevent additional elongation under pressure. 12" and larger sizes operating above 100 psi shall employ control cables with end fittings isolated by means of ½ " thick bridge bearing neoprene washer bushings designed for a maximum of 1000 psi.

C. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies.

D. Elbows shall be Mason-Flex type MFNEC, straight connectors Mason-Flex type MFTFU or MFTNC, and control cable assemblies type ACC.

E. Metal Flexible Connectors: Fabricated of Grade E phosphor bronze, monel or corrugated stainless steel tube covered with comparable bronze or stainless steel braid restraining and pressure cover. Sizes 3" and larger shall be flanged. Sizes 2 ½ " and smaller shall have male nipples. Lengths shall be as indicated:

Nominal Diameter (Inches)	Length (Inches)
½ "	12"
3/4"	12"
1 ½ "	12"
1 ½ "	12"
2"	12"
2 ½ "	12"
3"	18"
4"	18"
5"	24"
6"	24"
8"	24"
10"	24"
12"	36"
14"	36"
16"	36"

F. Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible. Hoses shall be type BSS.

PART 3. EXECUTION

3.1. GENERAL PROVISIONS

A. Install vibration-and-noise isolation materials and equipment as indicated and in accordance with machinery manufacturer's instructions.

B. Where neoprene elements of vibration isolator may be subjected to high pipe temperatures above 160°F, provide metal heat shields or thermal isolators.

C. A minimum of 4" thick reinforced concrete housekeeping pads shall be provided under all

floor mounted equipment. Rest subbases on structural floor and reinforce with steel rods interconnected with floor reinforcing bars by tie bars hooked at both ends. Provide at least one (1) inch clearance between subbases and inertia bases, steel bases, and steel saddles with machinery in operation.

D. All vibration isolators exposed to weather or humid environment shall be hot dipped galvanized with springs coated with neoprene in accordance with paragraph hereinbefore described.

E. Concrete inertia bases shall be a minimum of two (2) times the weight supported. Clearance between the underside of the inertia base and the housekeeping pad below shall not be less than 1 inch. Concrete shall be 3000 psi. Install inertia bases in accordance with the recommendations of the machinery manufacturer and the inertia base manufacturer.

F. Anchor Bolts and Grout: Secure machinery to foundations and inertia bases with anchor bolts. Grout equipment with baseplates, the full area under baseplates with premixed non-shrinking grout. After grout has set, remove wedges, shims, and jack bolts and fill spaces with grout.

G. Common Machinery Foundations: Mount electrical motors on the same foundations as driven machinery. Support piping connections, strainers, valves, and risers on the same foundation as the pumps.

H. Thrust Restraints: Where required, provide pairs of thrust restraints, symmetrically installed on both sides of the steady state line of thrust.

I. Machinery: Provide vibration isolators, flexible connectors and seismic snubbers in accordance with manufacturer's recommendations. Machinery with spring isolators or protected spring isolators shall rock or move freely within limits of stops or seismic snubber restraints.

J. Stability: Isolators shall be stable during starting and stopping of machinery without traverse and eccentric movement of machinery that would damage or adversely affect the machinery or attachments.

K. Lateral Motion: The installed vibration isolation systems for each piece of floor or ceiling mounted machinery shall have a maximum lateral motion under machinery start up and shut down conditions of not more than ¼ -inch. Restrain motions in excess by approved spring mountings.

L. Unbalanced Machinery: Provide foundation suspension systems specifically designed to resist horizontal forces for machinery with large unbalanced horizontal forces. Vibration isolator systems shall conform to the machinery manufacturer's recommendations.

M. Nonrotating Machinery: Mount nonrotating machinery in systems which includes rotating or vibrating machinery on isolators having the same deflection as the hangers and supports for the pipe connected to.

N. Vibration isolation ceiling hangers shall be installed so that the hanger rods do not touch the sides of the isolator housing, thereby seriously degrading the vibration isolation performance. Vibration isolation ceiling hangers shall be located so that the hanger

housing may rotate 360o without touching any object.

O. Electrical Connections: Provide flexible conduit or multiple conductor cable connections for machinery with sufficient extra length to permit 2 inch minimum displacement in any direction without damage.

P. Systems Not To Be Vibration Isolated: Do not provide vibration isolation for electrical raceways and conduits or for fire protection, storm, sanitary, and domestic water piping systems which do not include pumps or other vibrating, rotating, or pulsating equipment including control and pressure reducing valves.

Q. Install in accordance with manufacturer's instructions.

R. Install isolation for motor driven equipment.

S. Bases:

1. Set steel bases for one inch (25mm) clearance between housekeeping pad and base.

2. Set concrete inertia bases for 2 inch (50mm) clearance between housekeeping pad and base.

3. Adjust equipment level.

T. Install spring hangers without binding.

U. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

V. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

W. Connect wiring to isolated equipment with flexible hanging loop.

3.2. PIPE ISOLATION

A. Horizontal Pipe Isolation:

1. Precompressed Suspension Spring Isolators:

a. For the first three pipe hangers in the main lines near the mechanical equipment provide precompressed suspension spring isolators. Floor supported piping shall rest on trained spring isolators. All precompressed suspension spring isolators hangers or the first three trained spring isolators mounts as noted above, will have the same static deflection as specified for the mountings under the connected equipment. If piping is connected to equipment located in basements and hangs from ceiling under occupied spaces, the first three hangers shall have 0.75" deflection for pipe sizes up to and including 3", 1.5" deflection for pipe sizes up to and including 6" and 2.5" deflection thereafter. All other hangers and mounts will have a minimum steel spring deflection of 0.75". Hangers

shall be located as close to the overhead supports as practical.

B. Floor-Supported Piping:

1. Floor supports for piping in equipment rooms and adjacent to isolated equipment shall use vibration isolators as described hereinbefore and selected to the guidelines of hangers.

2. The first three adjacent floor supports shall be the restrained spring type with a blocking feature that prevents load transfer to equipment flanges as the piping is filled and drained.

3. Where piping is subject to larger thermal movement a slide plate shall be installed on the top of the isolator. Slide plate shall be teflon, graphite or steel.

4. Provide a thermal barrier where neoprene products are installed directly beneath hot water lines.

C. Pipe Risers: Provide pipe riser supports with bearing plates and two layers of ¼ " thick ribbed or waffled neoprene pad loaded to not more than 50 psi. Separate isolation pads with ¼ " steel plate. Weld pipe riser clamps at anchor points to the pipe and to pairs of vertical acoustical pipe anchor mountings which shall be rigidly fastened to the steel framing.

D. Supports at Base of Pipe Risers: Piping isolation supports at the base of risers shall be two layers of ½" thick heavy-duty neoprene pad separated by ¼ " thick steel plate. Use bearing plates sized to provide a pad loading of not more than 500 psi. Weld the stanchion between the pipe and isolation support to the pipe and weld or bolt to the isolation support. Bolt isolation support to the floor slab with resilient sleeves and washers. Where supplementary steel is required to support piping, provide a maximum deflection of 0.08 inches at the mid-span of this steel under the load. Rigidly support piping from the supplementary steel with the supplementary steel isolated from the building structure with isolators.

E. Pipe Anchors: Attach each end of the pipe anchor to an omni-directional pipe isolator which in turn shall be rigidly fastened to the steel framing or structural concrete. Provide a telescoping pipe isolator of two sizes of steel tubing separated by a minimum ½ " thick pad of heavy-duty neoprene or heavy-duty neoprene and canvas. Provide vertical restraints by similar material to prevent vertical travel in either direction. The load on the isolation material shall not exceed 500 psi.

3.3. FLEXIBLE PIPE CONNECTORS

A. Provide flexible connectors in accordance with manufacturer’s instructions where piping systems serving vibration isolated equipment and as shown on the drawings. Flexible connectors shall be installed near the connection to the equipment. Where liquid pulsation dampening is required, flexible connectors with spherical configuration may be used. Provide restraints for pipe connectors at pumps to prevent connector failure upon pump start-up.

3.4. ISOLATION FOR SPECIFIC EQUIPMENT

A. The vibration isolator manufacture shall provide isolators for all pieces of equipment provided for the job. Isolator shall be selected by the isolator manufacturer on the basis of criteria as specified in the ASHRAE Applications Handbook, latest edition, unless a more stringent requirement is indicated on the drawings.

B. Pumps:

1. All base mounted pumps shall be mounted on concrete inertia bases supported on stable steel springs in series with ribbed neoprene pads selected for not less than 1.5 inch static deflection under full operating load. Mason Industries type SLF or as approved equal.

2. Floor support of the initial pipe elbows at the pump discharge and suction diffuser at the pump intake shall be made from the isolated inertia base, not from the equipment room floor. Mason Industries Type K or as approved equal.

3. Provide flexible pipe connections at pump suction and discharge. Mason Industries Type BSS or MFTNC/MFTFU with control rods type ACC or as approved equal.

C. Fans:

1. Fans up to 22" wheel diameter shall be mounted stable steel springs in series with ribbed neoprene pads selected for not less than 1.5" static deflection (Mason Industries Type SLF or equivalent).

2. All fans suspended from the ceiling, joists or roof structure, including outside air fans, return fans, relief air, ventilation fans, and exhaust fans, shall be suspended using hangers incorporating steel springs in series with neoprene, selected for not less than 3.5" static deflection under full load (Mason Industries Type 30N or equivalent).

3.5. MANUFACTURER'S FIELD SERVICES

A. Inspect isolated equipment after installation and submit report. Include static deflections.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, & BALANCING FOR HVAC

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SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1. GENERAL

1.1. GENERAL

A. This section covers performance testing, adjusting and balancing of heating, ventilating, air conditioning and domestic re-circulating systems as specified in Division 23 Section 23 06 00 Heating, Ventilating, and Air Conditioning Equipment.

B. For Common Work Results of HVAC, See Division 23 Section 23 05 00 See Division 01 for General Requirements.

C. The mechanical contractor shall select and employ an impartial, independent balancing agency to provide testing and balancing services for the heating, ventilating and air conditioning (HVAC) systems and other specified systems of this project.

D. The work included in this section consists of furnishing labor, instruments, and tools required in testing, adjusting and balancing the HVAC and plumbing systems, as described in these specifications or shown on accompanying drawings. Services shall include checking equipment performance, taking the specified measurements, and recording and reporting the results.

E. The items requiring testing, adjusting, and balancing include, but are not limited to, the following:

1. Air Systems:

    a. Exhaust Fan
    b. Cooling Tower Fans

2. Hydronic Systems:

    a. Chillers (Refurbished)
    b. Cooling Towers (Refurbished)
    c. Flow Measuring Station
    d. Flow Meter Fittings
    e. Condenser Water Pump

3. In addition, any existing fans, equipment or air devices specified to be re-used under this project shall be tested and balanced, similar to new fans.

1.2. EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Systems are started and operating in a safe and normal condition.

2. Temperature control systems are installed complete and operable.

3. Proper thermal overload protection is in place for electrical equipment.

4. Final filters are clean and in place. If required, install temporary media in addition to final filters.

5. Duct systems are clean of debris.

6. Fans are rotating correctly.

7. Air coil fins are cleaned and combed.

8. Access doors are closed and duct end caps are in place.

9. Duct system leakage is minimized.

10. Hydronic systems are flushed, filled, and vented.

11. Pumps are rotating correctly.

12. Proper strainer baskets are clean and in place.

13. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.

C. Beginning of work means acceptance of exiting conditions.

1.3. QUALIFICATIONS OF THE BALANCE AGENCY

A. The balancing agency shall be a member of the Associated Air Balance Council (AABC).

B. The certified test and balance engineer shall be responsible for supervision and certification for the total work herein specified.

C. All final reports shall be signed by the certified test and balance engineer.

1.4. PRE-BALANCING CONFERENCE

A. Convene a conference one week prior to commencing work of this Section with all appropriate individuals.

1.5. STANDARDS

A. The balancing agency shall perform the services specified herein in accordance with the Associated Air Balance Council's National Standards, including revisions, to the date of the contract.

B. All terms in this specification shall have their meaning defined as stated in the National Standards.

C. ASHRAE III: Practice for measurement, testing, adjusting and balancing of building heating, ventilation, air conditioning, and refrigeration systems.

D. NEBB: Procedure standards for testing, adjusting, and balancing of environmental systems.

E. SMACNA: HVAC systems testing, adjusting, and balancing.

F. AABC: Associated Air Balance Council

1.6. COORDINATION

A. It will be necessary for the balancing agency to perform its services in close coordination with the mechanical contractor.

B. The plans and specifications have indicated meters, valves, dampers, and other devices for the purpose of adjusting the system to obtain optimum operating conditions. It will be the responsibility of the mechanical contractor to install these devices in a manner that will leave them accessible and readily adjustable. The balancing agency shall provide guidance if there is a questionable arrangement of a control or balancing device.

C. The general contractor, mechanical contractor, temperature control contractor and suppliers of the HVAC equipment shall all cooperate with the balancing agency to provide all necessary data on the design and proper application of the system components.

1.7. INSTALLATION TOLERANCE

A. Unless otherwise indicated, all air devices shall be adjusted to within plus or minus 10 percent of design. All fans shall be adjusted to within plus or minus 5 percent of design. All pumps and Hydronic equipment shall be adjusted to within plus or minus 5 percent of design.

1.8. RESPONSIBILITIES OF THE MECHANICAL CONTRACTOR

A. The mechanical contractor shall sufficiently complete the installation and start all HVAC systems to insure they are working properly and shall perform all other items as described hereinafter to assist the balancing agency in performing the testing and balancing of the HVAC system.

B. Record equipment manufacturer's standard start-up information and submit to Engineer for review. Testing and balancing work shall not commence on any equipment until start-up reports have been completed, reviewed by Engineer, and forwarded to Testing and Balancing Agency.

C. Air Distribution Systems

1. Verify installation for conformity to design.

2. Terminate all supply, return, outside air, exhaust air, relief air, ventilation air ducts, and pressure test them for leakage. Test pressure and leakage rate shall be as specified in Division 23 Section 23 30 00 “HVAC Air Distribution” under Leakage

Tests. Pressure testing shall be performed by mechanical contractor and witnessed by Test and Balance Engineer.

3. Ensure that all fans are operating and free of vibration. All fans and drives shall be checked for proper fan rotation and belt tension. Overload protection shall be of proper size and rating. A record of motor current and voltage shall be made to verify that the motors do not exceed nameplate rating. Record thermal overload ratings for all motors in the Test and Balance Report.

4. Make any necessary changes to the sheaves, belts, and dampers, as required by the balancing agency, at no additional cost to the owner.

D. Water Circulating Systems

1. Verify installation for conformity to design.

2. Check all pumps to verify pump alignment and rotation.

3. Ensure that systems are clean, with the proper strainer screens installed for normal operation.

4. Check all pump motors for current and voltage, to ensure that motors do not exceed nameplate rating.

5. Provide thermal overload protection of proper size and rating. Record thermal overload ratings for all motors. Insert data in Test and Balance Report.

6. Ensure that all water circulating systems shall be full and free of air; that expansion tanks are set for proper water level; and that all air vents were installed at high points of systems and are operating.

1.9. RESPONSIBILITIES OF THE TEMPERATURE CONTROL CONTRACTOR

A. The temperature control contractor shall complete the installation of the temperature control system, and operate and test all control systems to ensure they are functioning properly as designed. The temperature control contractor shall assist the balancing agency in testing and balancing the HVAC systems, as described hereinafter.

1. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air and water reset, freeze stats and duct smoke detectors.

2. Verify that all controlling instruments are calibrated and set for design operating conditions.

3. Calibrate temperature sensors after installation, and before the temperature sensors control verification tests are performed. The balancing agency shall prove the accuracy of final settings by taking temperature readings. The readings shall be in a typical conditional space for each separately controlled zone.

4. The temperature control contractor shall allow sufficient time in the project to

provide assistance and instruction to the balancing agency in the proper use and setting of control components such as, but not limited to, computers, static pressure controllers, or any other device that may need set points changed so that the testing and balancing work can be performed.

B. All control sequences, software, equipment, and components shall be started-up by a qualified technician. Start-up report shall be submitted to Engineer prior to the commencement of testing and balancing work. Testing and balancing shall not commence until start-up reports are completed, reviewed by Engineer and forwarded to Testing and Balancing Agency.

1.10. NOTIFICATION FOR TESTING AND BALANCING WORK TO BEGIN

A. The mechanical contractor shall notify the balancing agency in writing when all heating, ventilating, and air conditioning systems are complete and ready for testing and balancing. The mechanical contractor shall attest that he has completed all items as herein described.

B. The following must be completed prior to start of system balancing:

1. All duct work and associated dampers installed and completed.

2. Piping systems completed, flushed and filled.

3. Equipment properly started by qualified personnel or start-up technicians.

4. Automation system (temperature controls) installed and completed for both air and water systems.

5. All equipment controlled in automatic (“Auto”) mode.

6. Access granted to the balancing contractor to the automation/controls system provided.

1.11. DEFICIENCIES

A. Any deficiencies in the installation or performance of a system or component observed by the TAB agency shall be brought to the attention of the appropriate responsible person.

B. The work necessary to correct items on the deficiency listing shall be performed and verified by the affected Contractor before the TAB Agency returns to retest. Unresolved deficiencies shall be noted in the final report.

1.12. ADJUSTING

A. Ensure recorded data represents actual measured observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring all sensors to specified settings.

E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

F. Check and adjust systems approximately six months after final acceptance and submit report.

G. Permanently mark the locations of all duct traverses on the exterior surface of the duct insulation.

1.13. ALTERNATES

A. Refer to Division 01 Section 01 23 00 “Alternates” for description of work under this section affected by alternates.

1.14. GENERAL COMMISSIONING REQUIREMENTS

A. Refer to Division 01 Section 01 91 13 “General Commissioning Requirements” for description of work under this Division affected by General Commissioning.

PART 2. PRODUCTS (NOT APPLICABLE)

PART 3. EXECUTION

3.1. GENERAL

A. Perform all testing and balancing in complete accordance with AABC National Standards for Field Measurements and Instrumentation.

B. Furnish all test instruments and equipment. All instruments must have been calibrated within twelve (12) months prior to use and shall be checked for accuracy prior to and during the work. Submit certificate for calibration of all equipment utilized on project with date of calibration clearly identified.

C. Review all systems designs and equipment, manufacturers’ data, and be completely familiar with the work before proceeding.

D. Report all malfunctions or deficiencies to the contractor so that corrective action can be taken. Test and Balance Report shall not be submitted for review until all malfunctions or deficiencies are corrected. Repeat tests where required until design conditions are achieved.

E. Where systems or equipment cannot be balanced or adjusted to design conditions, determine the cause and submit a complete report to the Engineer.

F. Retest or rebalance the system as required during the warranty period.

G. Test and balance all systems under adequate load condition. If, in the opinion of the Engineer, there is insufficient load to properly test and balance the systems, perform sufficient preliminary balancing and adjustment to permit operation of the systems until

such time as final testing and balancing can be done. Provide in writing the future date when systems shall be tested under sufficient load.

H. At project completion provide a complete set of ½ scale drawings indicating the locations of all duct traverses.

3.2. EXAMINATION

A. 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.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. 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.

E. Examine equipment performance data including fan and pump curves.

1. 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.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

I. Examine strainers. Verify that startup screens are replaced by permanent screens and indicated perforations.

J. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

K. Examine system pumps to ensure absence of entrained air in the suction piping.

L. Examine operating safety interlocks and controls on HVAC equipment.

M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3. AIR SYSTEM PROCEDURES

A. The balancing agency shall perform the following testing and balancing functions in

accordance with the Associated Air Balance Council's National Standards:

1. Fan Speeds - Test and adjust fan RPM to achieve design CFM requirements.

2. Current and Voltage - Measure and record motor current and voltage. Check and record thermal overload ratings for all motors.

3. Pitot-Tube Traverse - Perform a Pitot-tube traverse of main supply, return and exhaust ducts to obtain total CFM. If a Pitot-tube traverse is not practical, the summation of the outlets or inlets may be used. An explanation why a traverse was not made must appear on the appropriate data sheet.

4. Outside Air - Test and adjust system minimum outside air by Pitot-tube traverse. If a Pitot-tube traverse is not practical, the percentage of outside air may be determined by calculations from the return air, outside air, and mixed air temperatures. Make allowances for heat of compression and motor heat where applicable.

5. Static Pressure - Test and record system static pressures, including suction and discharge static pressure of each fan.

6. Main Ducts - Adjust main ducts to within design CFM requirements and traverse for total CFM quantities.

7. Description - Record the size, type, and manufacturer of each diffuser, grille, and register on air outlet data sheets.

8. Test and Balance Engineer shall witness and record all leakage testing of ductwork. Leakage test data shall be included in final Test and Balance Reports.

9. Measure temperature conditions across exhaust dampers to check leakage.

10. Testing cooling tower per AABC basic test for a cooling tower.

3.4. WATER SYSTEM PROCEDURES

A. The various water circulating systems shall be filled, purged of air, and put into operation before hydronic balancing by the mechanical contractor.

B. The flow of water through all coils shall be adjusted by manipulating balancing valves until the rated pressure drop through the coil or metering device is obtained. Perform balancing by measurement of temperature differential in conjunction with air balancing.

C. The balancing agency shall perform the following testing and balancing functions in accordance with the AABC National Standards.

D. All Hydronic equipment and HVAC pumps shall be Tested and Balanced as described below:

1. Water Treatment - Examine the water in the system and determine if the water has been treated and cleaned. If it has not, request the mechanical contractor to clean and treat the water prior to TAB work

2. Strainers - Request that the mechanical contractor clean all strainers.

3. Air Vents - Check all air vents at the high points of the water system and determine if they are installed and operating.

4. Valves - Set all balancing valves to the full-open position for balancing.

5. Pumps - Adjust all pumps to meet design GPM requirements. Check pumps for proper operation. Pumps shall be free of vibration and cavitation. Measure and record operating current and voltage. Check and record thermal overloads installed on all pumps. Record in Test and Balance Report.

6. Tolerances - Proceed to balance all coils, pumps, balance valves chillers, to within 5 percent of design requirements.

7. Marking - Mark all settings and record all data after completing the flow readings and coil adjustments.

8. Where available pump capacity (due to diversity) is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

9. Test cooling tower per AABC basic test requirements for a cooling tower.

E. Chillers:

1. Verify that chillers have been started by others and are in operation. Test and adjust chiller water flows to achieve maximum or design GPM.

2. Current and Voltage - Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure compressor motor is not in or above the service factor.

3. Test and record temperature profiles of chiller for both the evaporator and condenser.

4. Description of liquid sufficient to obtain physical properties.

5. Power input to controls and auxiliary components in KW.

6. Condenser water flow rate and temperatures.

7. Test operation of flow switches.

F. Cooling Towers:

1. Verify that cooling towers have been filled and started by others, and are in operation. Test cooling tower fans for proper RPM and airflow.

2. Test and adjust water flows to balance tower cells.

3. Test and record temperature profiles for water and air side operation.

4. Current and Voltage: Test and record motor voltage and amperage, and compare with nameplate limits to ensure fan motor is not in or above service factor.

3.5. TESTING AND BALANCING OF EXISTING SYSTEMS

A. The balancing agency shall perform testing and balancing of existing pump systems to the extent indicated.

B. Test and Balance Agency shall assist the mechanical contractor in selection of new sheaves and belts, if required. Re-sheaving of existing air handling units or fans shall be done at no additional cost to owner. Where required, new sheave and belt size calculations shall be forwarded to the Engineer for review and approval.

C. The Test and Balance Agency shall perform air system procedures (here-in before specified) on the following existing systems.

1. Cooling Tower (Refurbished).

D. The Test and Balance Agency shall perform water system procedures (here-in before specified) on the following hydronic systems.

1. Chiller (Refurbished)

2. Cooling Tower (Refurbished),

3. Dual Temperature Pumps #1, 2, 3, and 4.

4. Provide temperature measurements across Existing Chillers (Refurbished) and Existing Cooling Tower (airside and waterside).

3.6. LIFE SAFETY CONTROLS TESTING PROCEDURES

A. The TAB agency shall test and record life safety control operation on the HVAC equipment. It shall verify the installation of required smoke detectors in air handling equipment (AHE), and shall verify operation of the smoke detector by activating the smoke detector and observing air handler shutdown. With the controls and alarm contractors, the TAB agency shall verify the operation of interconnected systems such as the AHU smoke detector’s activation of the fire alarm system and the alarm system’s activation of the life safety control sequences. Record results of tests within TAB report.

3.7. VERIFICATION OF TEMPERATURE CONTROL

A. The balancing agency shall be assisted by the temperature control contractor in verifying the operation and calibration of all temperature control systems. The following tests shall be conducted:

1. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air and water reset.

2. Verify that all controlling instruments are calibrated and set for design operating conditions.

3. Verify the accuracy of the final settings by taking temperature readings. The readings shall be in a typical conditioned space for each separately controlled zone.

4. Test and calibrate all differential pressure sensors. Record set point in Record and Information Books.

3.8. TEST AND BALANCE REPORTS

A. The test and balance report shall be complete with logs, data, and records as required herein. All logs, data, and records shall be typed on white bond paper and bound. The report shall be certified accurate and complete by the balancing agency's certified test and balance engineer.

B. Six (6) copies of the test and balance report are required and shall be submitted to the Engineer. If, in the opinion of the Engineer, test results or portions thereof are incomplete or inconclusive, repeat necessary portions of the work to the satisfaction of the Engineer.

C. The report shall contain the following general data in a format selected by the balancing agency:

1. Project Number

2. Contract Number

3. Project Title

4. Project Location

5. Project Mechanical Engineer

6. Test & Balance Agency

7. Test & Balance Engineer

8. General Contractor

9. Mechanical Subcontractor

10. Dates tests were performed

11. Certification

12. Duct Leakage Tests

13. Phone Numbers of all Individuals Listed Above

D. The test and balance report shall be recorded on report forms conforming to the recommended forms in the AABC National Standards.

3.9. TEST REPORT FORMS

A. Air Moving Equipment and Fan Test Forms - Submit fan curve showing design and

operating points of operation. Also, record the following on each fan equipment test form:

1. Manufacturer, model number, serial number, arrangement.

2. All design and manufacturer-rated data.

3. Total actual CFM by traverse if practical. If not practical, the sum of the outlets may be used, or a combination of each of these procedures. For specific systems, such as ones with diversity, see the AABC National Standards.

4. Suction and discharge static pressure of each fan, as applicable.

5. Exhaust air total CFM.

6. Actual operating current, voltage and brake horsepower of each fan motor.

7. Final RPM of each fan.

8. Fan and motor sheave manufacturer, model, size, number of grooves, bore, and center distance.

9. Belt size, quantity and make.

10. Total and external static pressure.

B. Pump Test Forms - Submit pump curve showing design, operating, and no-flow points of operation. Also, record the following items on each pump test form:

1. Manufacturer, size, model, service and serial number.

2. All design and manufacturer's rated data.

3. Pump operating suction and discharge pressure and final total dynamic head.

4. No flow (pump discharge valve closed) suction and discharge pressure and corresponding total dynamic head. This procedure is to determine actual impeller size. Record impeller size.

5. Rated and actual operating current, voltage, and brake horsepower of each pump motor.

6. Total operating head pressure.

7. Shutoff, discharge and suction pressures.

8. Shutoff, total head pressure.

C. Chiller Test Forms - Record the following items on each chiller test form:

1. Manufacturer model number, serial numbers.

2. All design and manufacturer's rated data.

3. Service and location.

4. Actual pressure drop and related GPM primary side.

5. Actual pressure drop and related GPM, secondary side.

6. Primary side entering and leaving temperatures.

7. Secondary side entering and leaving temperatures.

8. Temperature control settings.

9. Electrical characteristics.

10. Refer to Owner's original submittal for design data.

D. Flow Measuring Station Test Forms:

1. Identification/location.

2. Manufacturer.

3. Size and Model Number.

4. Design and Actual Flow Rate.

5. Design and Actual Pressure Drop.

6. ATC flow rate versus field measured flow rate.

E. Electric Motors Test Forms: (Applies to all motors, including pumps, fans and HVAC equipment)

1. Manufacturer.

2. Model/Frame.

3. HP/BHP.

4. Phase, voltage, amperage; nameplate, actual, no load.

5. RPM.

6. Service factor.

7. Starter size, rating, heater elements.

8. Sheave Make/Size/Bore.

9. Thermal overload settings

F. V-Belt Drive Test Forms:

1. Identification/location.
2. Required driven RPM.
3. Driven sheave, diameter and RPM.
4. Belt, size and quantity.
5. Motor sheave diameter and RPM.
6. Center to center distance, maximum, minimum, and actual.

G. Cooling Tower Test Forms:

1. Tower identification/number.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Rated Capacity.
6. Entering air WB temperature, specified and actual.
7. Leaving air WB temperature, specified and actual.
8. Ambient Air DB temperature, specified and actual.
9. Condenser water entering temperature, specified and actual.
10. Condenser water leaving temperature, specified and actual.
11. Condenser water flow rate, specified and actual.
12. Fan RPM, specified and actual.
13. Refer to Owner’s original submittal for specified data.

H. Duct Traverse Test Forms:

1. System zone/branch.
2. Duct size.
3. Area.
4. Design velocity.
5. Design air flow.

6. Test velocity.

7. Test airflow.

8. Duct static pressure.

9. Air temperature.

10. Air correction factor.

I. Duct Leakage Test Forms:

1. Description of ductwork under test.

2. Duct design operating pressure.

3. Duct design test static pressure.

4. Duct capacity, air flow.

5. Maximum allowable leakage duct capacity times leak factor.

6. Test apparatus.

   a. Blower.
   b. Orifice, tube size.
   c. Orifice size.
   d. Calibrated.

7. Test static pressure.

8. Test orifice differential pressure.

9. Leakage.

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SECTION 23 06 00
HEATING, VENTILATING, AND AIR CONDITIONING EQUIPMENT

PART 1. GENERAL

1.1. GENERAL

A. The Conditions of the Contract and other General Requirements apply to the work specified in this section. All work under this section shall also be subject to the requirements of Division 23 Section 23 05 00 Common Work Results for HVAC and Division 01 Section General Requirements.

1.2. DESCRIPTION

A. The work to be performed shall include all labor, materials and equipment necessary to furnish and install complete, all mechanical equipment as shown on drawings, hereinafter specified or reasonably implied, and leaving the same in satisfactory operation condition. It is the intent that systems be installed complete with all items necessary to accomplish this purpose.

1.3. SUBMITTALS

A. Shop Drawings: Indicate assembly, equipment dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

B. Product Data:

1. Provide literature which indicates dimensions, weights, capacities, ratings, performance, gages and finishes of materials, and electrical characteristics and connection requirements.

2. Provide data of filter media, filter performance data, filter assembly, and filters frames.

3. Provide fan and pump curves with specified operating point clearly plotted.

4. Submit sound power level data for both fan outlet and casing radiation at rated capacity. Submit sound power levels by octave band or sound pressure levels by octave band for all equipment.

5. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

1.4. OPERATION AND MAINTENANCE DATA

A. Maintenance Data: Include instructions for lubrication, filter replacement, motor and

drive replacement, spare parts lists, and wiring diagrams.

1.5. DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of General Requirements.

B. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

C. Store all equipment in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

D. Comply with manufacturer's installation instructions for rigging, unloading and transporting equipment.

E. Protect all motors, shafts, and bearings from weather and construction dust.

1.6. ENVIRONMENTAL REQUIREMENTS

A. Do not operate any equipment for any purpose, temporary or permanent, until ductwork/piping is clean, filters/strainers are in place, bearings lubricated, and equipment has been test run under observation.

1.7. ALTERNATES

A. Refer to Division 01 Section 01 23 00 “Alternates” for description of work under this section affected by alternates.

1.8. EXTRA MATERIALS

A. Provide one set of seals for each type and model of pump provided on the project.

PART 2. PRODUCTS

2.1. FANS

A. General

1. Provide fans as indicated on the drawings. All fans shall have been tested and their performance rated in accordance with Air Movement and Control Association, Inc., Bulletin 210-85 Test Code and shall be licensed to bear the AMCA Seal. All fans shall carry the AMCA Certified Rating Seal for air and sound. Sound power levels shall be submitted for approval. Fan curves shall be submitted with all fan shop drawings.

2. Fan manufacturer shall submit under what duct configuration (unducted, partially ducted, or ducted) the manufacturer certified the performance of a particular fan or group of fans.

B. In-Line Centrifugal Fans

1. Belt Drive

   a. Furnish and install in-line centrifugal belt drive fans of the size, capacity and electrical characteristics as shown on contract drawings.
   b. Duct mounted fans shall be of the centrifugal belt driven in-line type. The fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars.
   c. Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components. All in-line fans shall be factory insulated. The housing interior shall be insulated with 1-inch acoustical insulation.
   d. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.
   e. Motors shall be heavy duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted out of the airstream. Motors shall be readily accessible for maintenance. Motors shall be high efficiency type.
   f. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed.
   g. Drives shall be sized for a minimum of 150 percent of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
   h. Motor pulleys shall be adjustable for final system balancing.
   i. All fans shall bear the AMCA Certified Ratings Seal for both sound and air performance.
   j. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.
   k. Fans shall be Model BSQ as manufactured by Greenheck Fan Corporation, ACME Engineering, Penn Ventilator, Cook, Twin City Fan and Blower or approved equal.

2.2. REFURBISHMENT OF EXISTING WATER COOLED CHILLER COMPONENTS

A. The existing water cooled chiller shall be refurbished per the following scope of work. Chiller shall be winterized by Owner prior to work beginning. All water cooled chiller refurbishing activities shall be performed by a York Factory Authorized Service Company or equipment manufacturers who has completed a minimum of five (5) chiller refurbishment projects of similar or larger size within the past three (3) years.

   1. Manufacturer: York, Model #YKCBDBG4-CLE, Serial #SNJM162020.

B. Chiller Starter

   1. Furnish one (1) new solid state starter for existing York chiller. Starter shall be a digital bypass solid state starter as manufactured by RAM Industries, LLC or

approved equal. Starter shall have the following features.

2. Starter Overview

   a. The DBS (digital bypass solid state) reduced-voltage starter is a microprocessor controlled motor starting device which utilizes six SCRs (silicon controlled rectifiers) to electronically reduce the applied voltage to an AC induction motor, allowing the motor to start at a reduced current because the DBS accelerates the motor in a smooth stepless manner, it reduces drop in the supply voltage as well as mechanical shock on the driven equipment, that is normally experienced with two-step, electromechanical, reduced-voltage starting methods. The DBS can be programmed to provide a gradual buildup of torque, from zero to almost full motor locked rotor torque, or to limit starting currents to a constant value, which prevents an excessive voltage drop during motor starting.

3. Starter Standard Features

   a. Universal Source Matching: The DBS automatically adjusts itself to any input voltage between 200 and 600 VAC and any frequency from 45 to 65 Hz.
   b. Closed Loop Starting: The DBS starts a motor in a continuous controlled current mode, which eliminates mechanical shock to the motor.
   c. Automatic Bypass: The DBS shall include a bypass contactor that is automatically engaged after the motor has reached full speed, or when the bypass delay has expired. The bypass contactor shall reduce power losses and heat build-up so that the DBS controller, in an unventilated enclosure in a 40°C ambient, can continuously operate a fully-loaded motor.
   d. Electronic Motor Overload Protection: The DBS shall include integral electronic motor protection. This micro-processor-based feature provides comprehensive motor overload protection as well as monitoring and annunciating system alarm and shutdown conditions.
   e. LED Diagnostics: The DBS shall have four (4) LEDs provided on the front of its control board to indicate the operating state of the DBS.
   f. Starting Modes: Two starting modes shall provide optimum performance to match the DBS to the motor load characteristics:
      i. Constant Current Mode: Starting current shall be limited to a maximum level, adjustable from 200-425% of FLA, until the motor attains full speed.
      ii. Step Ramp (Current Ramp) Mode: After the starting current quickly reaches the current step limit, it can ramp up to 500% FLA. The ramp time allowed can be set from 3-30 seconds.
   g. Control Modes: Two control operating modes shall be available: Display and Network.
   h. UL and CUL Approved: All models have been tested and approved by Underwriters Laboratory per
   i. UL 508 Standard, and conform to Canadian National standards.
   j. Provide power factor correction capacitors for starter connected on line

side of DBS controller.

k. Provide main input circuit breaker with ground fault protection. Min. AIC rating shall be 65K AIC.

l. Starter enclosure shall be NEMA-1enclosure constructed per UL 50 requirements, and shall be galvanized steel with electrodeposited enamel finish.

m. Provide control power transformer and control power to existing chiller control panel as coordinated with York chiller manufacturer.

4. Starter System Parameters

a. The motor and load characteristics and the control method define system parameters. These are configured with switches on the control board of the DBS controller.
b. Full Load Amps (FLA)
c. Constant Current Level (% FLA)
d. Ramp Bypass Time (Seconds)
e. Control Mode (Display, Network)
f. Network Address (Quantum/Plus)
g. Overload Protection (Enabled / Disabled)
h. Starting Mode (Constant Current / Step Ramp)
i. Configuration (Inline)

5. Starter Control Modes

a. The DBS can be set up to operate in either the Display or Network control mode by means of DIP switches located on the DBS control board.
b. Display Mode: The control/display unit, mounted on the front of the enclosure door and connected to the DBS via an RS-232 port, provides the interface to program and monitor the DBS controller.
c. Network Mode: The Frick control system computer, connected to the DBS via the Network RS485 port, shall provide the interface to program and monitor the DBS controller.

6. Starter Operating States

a. The operating states, annunciated by means of status codes on the control/display unit, shall describe the DBS conditions seen by its microprocessor.
b. READY - The DBS is ready to start the motor. The DBS has passed all the preliminary system checks, including verifying there are no shorted SCRs, all internal system tests have passed, and no phase reversal or trip condition is present.
c. START - The DBS is in the process of starting the motor. Full speed has not been attained and the bypass contactor has not been turned on.
d. RUN - The motor has reached full speed, or the end of the bypass time has been reached, and the bypass contactor has been turned on.
e. TRIP - The DBS has detected a trip condition and stopped the motor.
f. COOLDOWN - The motor has exceeded its thermal capacity and will

not be allowed to start until enough time has elapsed to allow the motor to cool. The time until the motor can be re-started can be viewed in the Monitor Menu under "Time Till Start."

7. Starter LED Annunciation

   a. LEDs, located on the front of the DBS control board, annunciate operating status and assist in troubleshooting while the starter door is open.
   b. READY LED (Green) indicates the DBS is in the READY state.
   c. RUN LED (Green) indicates the DBS is in either the START or RUN state. The LED will blink when in the START state, then turn on steady once the RUN state is reached.
   d. ALARM LED (Yellow) indicates the DBS has detected an ALARM condition. The LED will blink until the alarm is acknowledged (see Section 8.3). When the condition is no longer present, the LED will go out, and normal operation can resume. If the condition is acknowledged, but is still present, the LED will turn on steady and remain on until the alarm condition is removed. The control/display unit or Frick computer will show the cause of the alarm.
   e. TRIP LED (Red) indicates the DBS is in the TRIP state. The LED will blink until the trip is acknowledged (see Section 8.3). When the trip condition is no longer present, the LED will go out, and normal operation can resume. If the condition is acknowledged, but is still present, the LED will turn on steady and remain on until the trip condition is removed. The control/display unit or Frick computer will show the cause of the trip.

8. Starter Electronic Motor Overload Protection and Monitoring

   a. The DBS shall electronically monitor and protect the motor, during both start and run states, by using, in addition to user presets, a unique model of operating limits for the motor created from three-phase current and voltage input signals. It also shall record pertinent operating history for troubleshooting and maintenance purposes.
   b. Fault conditions shall be annunciated and acknowledged through either the DBS door-mounted control/display unit or the Frick computer.
   c. The DBS electronic overload shall afford motor protection against the following conditions:
   d. Stalling
   e. Overheating
   f. Locked Rotor
   g. Additionally the DBS microprocessor will detect the following conditions:
   h. Jam
   i. Short Circuit
   j. Phase Loss
   k. Current Unbalance
   l. Phase Reversal

9. Starter Trip Conditions

   a. Multiple trip conditions shall be detected and displayed in either DBS control mode. The detection of a trip condition while the motor is running will cause it to stop
   b. SHORT CIRCUIT - This trip will occur if the current exceeds 800% FLA while the DBS is in the START state. This condition will activate the circuit breaker shunt trip.
   c. THERMAL OVERLOAD - This trip will occur when the calculated thermal energy stored in the motor exceeds 100% of the motor's thermal capacity. The motor shall be allowed to start again when the motor has sufficiently cooled.
   d. SHORTED SCR - This trip will occur if one or more of the SCRs is shorted. A trip will occur if line voltage / 1.73 is not present from line to load across each phase of the starter when the motor is properly connected. This voltage is checked only after a run signal is received. This trip will also occur if current flow is detected when the motor is not running. This current is an indication of a "runaway" motor and will result in the activation of the shunt trip.
   e. PHASE REVERSAL - This trip will occur if phase rotation on the incoming power is not: L1 - L2 - L3. A reversal condition is checked only after a run signal is received and can be corrected by swapping any two phases. Control power must be cycled to clear this fault.
   f. PHASE LOSS - This trip will occur if one or more of the incoming voltage phases is lost when the motor is not running. This voltage is checked only after a run signal is received. This trip will also occur if one or more of the current feedback signals on TB2 of the power board is lost when the motor is running.
   g. HEAT SINK OVERTEMPERATURE - This trip will occur when the DBS heat sink temperature has exceeded safe operating conditions.
   h. PLL FAILURE - Indicates poor power quality. This check is performed only when the DBS is in the START state.
   i. JAM - This trip will occur if the current is above the Jam Current Level and the Jam run delay has expired. This trip will occur only in the run state.

10. Starter Alarm Conditions

   a. An alarm condition shall be annunciated on the control/display unit or Frick computer and cause the yellow Alarm LED on the DBS control board to light.
   b. CURRENT UNBALANCE - This alarm shall be activated when the current unbalance % exceeds the Current Unbalance level and the Current Unbalance Delay has expired.

11. Starter DBS Specifications

AC POWER SUPPLY	200V TO 600V RMS
HP RATINGS	30-250 HP

CURRENT CAPACITY	69 AMPS – 900 AMPS
CONTROL VOLTAGE	115 VAC, +/- 15%
LINE FREQUENCY	45 TO 65 HZ
CONTROL VOLTAGE	B1, B2: 150 VA
VA DEMAND	B3, C1, C2, C3: 250 VA
PER CHASSIS SIZE	D1, D2, D3: 500 VA E1, E3: 750 VA
THERMAL OVERLOAD CAPACITY	300% FLA FOR 40 SECONDS 600% FLA FOR 10 SECONDS
OPERATING TEMPERATURE	0 TO 40 DEGREES C (32-104)
STORAGE TEMPERATURE	-40 TO 65 DEGREES C (-40-149)
STANDARD STARTING MODES	Constant Current - 200% To 425% Fla Step Ramp - 200% To 425% Fla, Ramp Up To 500% Fla Max
USER ACCESSIBLE RELAYS	Run Relay: (2) Spst Normally Open Contacts 10 Amps @ 25o Volt Ac, Inductive Rating Shunt Trip Relay: (1) Spst Normally Open Contact 10 Amps @ 250 Volt Ac, Inductive Rating Alarm Relay: (1) Spdt 1-Normally Open, 1-Normally Closed Contact 10 Amps @ 250 Volt Ac, Inductive Rating
COMMUNICATION PORTS	Display Port (J1) - Rs232, 9600 Baud Network Port -Rs485, 19,200 Baud; Receive (Rx) Led (Yellow) And Transmit (Tx) Led (Green) Indicate Network Activity. Jumpers Jp1 (+) And Jp3 (-) Select 10k

	Bias Resistors: 1-2 Enable, 2-3 Disable. Jumper Jp2 Selects 120ohm Termination Resistor: 1-2 Enable, 2-3 Disable

2.3. REFURBISHMENT OF EXISTING COOLING TOWER COMPONENTS

A. The existing cooling tower shall be refurbished per the following scope of work. Cooling tower shall be winterized by Owner prior to work beginning. All cooling tower refurbishing activities shall be performed by an established cooling tower restoration company or equipment manufacturer who has completed a minimum of five (5) cooling tower restoration projects of similar or larger size within the past three (3) years.

1. Existing Cooling Tower Manufacturer: Marley, Model #NC 4221CS. Serial No. 170301-002-00.

B. Fan Motor Replacement

1. Furnish, rig, and install one (1) new 25 HP, 208 Volt, 3 Phase, 60 Hz, 1800 RPM, Premium efficiency motor.

2. High Efficiency Inverter Duty, TEAO motor complete with new output shaft drive shaft coupling, into place on mounting plate on mechanical support.

3. Connect to new Variable Frequency Drive and new incoming electrical connections into new motor junction box.

4. Install new Variable Frequency Drive (VFD) with bypass option in a NEMA 4X enclosure. VFD will be mounted outside adjacent to tower. Refer to separate specifications for variable frequency drive. All wiring/conduit to VFD and from VFD to fan motor shall be completed as part of the refurbishment.

C. City Water Makeup Float Assembly Replacement

1. Furnish and install one (1) new City Water Mechanical Makeup Float assembly into place and set float ball to water level setting.

D. Custom Internal Walkway Installation

1. Furnish and install all materials and components for one (1) custom built Internal Walkway, stretching from access door to access door, to allow for access into the cooling tower unit without the need for draining down the cold water sump basin.

2.4. REFRIGERANT MONITORS

A. Provide a complete refrigerant leak detection system for 24 hour monitoring of refrigerant in the chiller room. Refrigerant type and electrical characteristics shall be as scheduled on the contract drawings. The refrigerant leak detection system shall comply

with ASHRAE Standards 15, latest edition.

B. Manufacturers shall include Chillgard by MSA Instruments, Frigrosniff by Blazers Corporation, Sherlock by Genesis International, Davis Instruments, Thermal Gas Systems, Foxboro, or approved equal.

C. Refrigerant monitor shall initiate emergency ventilation sequence and alarms as specified in Division 23 Section 23 09 00 Instrumentation and Controls for HVAC. All alarm, ventilation set points shall be fully adjustable. Unit shall be capable of displaying alarm conditions. Furnish unit with a minimum of three alarm levels with relays.

D. Refrigerant monitor shall provide instantaneous refrigerant concentration in parts per million (ppm).

E. Furnish each unit with multi point sequencer capable of monitoring up to four (4) remote locations.

F. Unit shall be capable of being connected to newer refrigerants in the future.

G. Accuracy: 0-100 ppm + 1 ppm; 100 - 1000 ppm + 10 percent reading.

H. Linearity: 0-100 ppm linear, 100 - 1000 + 2 percent of full scale.

I. Sensitivity: 1 ppm.

J. Resolution: 1 ppm.

K. Reproducibility: +1 ppm over 12 months at specified operating conditions.

L. Response: 90 percent of a step change in 70 seconds.

M. Operating temperature: 0-50 degree C, 32-122 degree F.

1. Temperature effect: + 0.3 percent per degree C of reading.

N. Relative humidity: 0-99 percent non-condensing - no effect on reading.

O. Sample flow rate: 1 liter/minute peak.

P. Maximum tubing length: 150 feet.

Q. Alarm relays: 3 relays @ 8 amps resistive.

1. Analog output: 0-10V, and 4-20mA isolated sourcing.

R. Maximum signal load: 0-10V into 2 kOhms, or 4-20mA into 1 kOhms.

S. Sample tubing connections: ¼-inch OD, 1/8-inch 1D.

T. Flow switch: Activates at flow - .05 liter/minute.

U. Enclosure Type: NEMA 4.

2.5. VARIABLE FREQUENCY DRIVES

A. Provide variable frequncy drive controller for existing cooling tower fan and new cooling tower fan motor as indicated on Contract Drawings and Specifications. Coordinate with cooling tower refurbishment specifications. Drive shall be subject to the requirements of this section.

B. The adjustable frequency controller (AFC) shall convert three phase 60 Hertz utility power to adjustable voltage and frequency, three phase, AC power for stepless motor control from 5 percent to 110 percent of base speed.

C. Unit shall be suitable for exterior wet location.

D. The AFC shall be a voltage source type with a PWM output utilizing power transistor semi-conductors.

E. The AFC together with all options and modifications shall mount within a standard NEMA 4X enclosure suitable for continuous operation at ambient temperature of 0 to 40 degrees C. with relative humidity to 95 percent non-condensing. All high voltage components within enclosure shall be isolated with steel covers. The complete unit shall be UL approved and UL labeled.

F. Circuits shall provide DV/DT and DI/DT protection for semi-conductors. AFC shall be capable of starting into a rotating load without delay. Protective circuits shall cause instantaneous trip (IET) should any of the following faults occur:

1. Motor overload.

2. Shortcircuit.

3. Motor over temperature fault.

4. Reverse phase.

5. 110 percent of controller maximum sine wave current rating is exceeded.

6. Output phase to phase and phase to ground short circuit condition.

7. High input line voltage.

8. Low input line voltage.

9. Loss of input phase.

10. External fault. This protective circuit shall permit, by means of the terminal strip, wiring of remote NC safety contacts such as high static, firestat, etc., to shut down the drive.

G. The following adjustments shall be available in the controller and retained in non-volatile memory:

1. Maximum frequency (15 to 400 Hz) factory set at 60 Hz.

2. Minimum frequency (3 to 60 Hz) factory set at 6 Hz.

3. Acceleration (.1 to 360 seconds) factory set at 20 seconds.

4. Deceleration (.1 to 360 seconds) factory set at 20 seconds.

5. Volts/Hertz ratio factory set for 460V at 60 Hz.

6. Voltage offset or boost factory set at 100 percent torque.

7. Current limit (50 percent to 110 percent sine wave current rating) factory set at 100 percent current.

H. The AFC shall have the following basic features:

1. Door-mounted operators controls consisting of a membrane command center which allows manual stop/start and speed control, local/remote indication and manual/or automatic speed control selection. In addition, the command center shall serve as a means to configure controller parameters such as min speed, max speed, acceleration and deceleration times, Volts/Hz ratio, torque boost etc. Potentiometers shall not be allowed for these settings.

2. Main input disconnect to provide a positive disconnect between the controller and all phases of the incoming A-C line. This disconnect shall be mounted inside the controller enclosure and have through-the-door interlocking toggle with provisions for padlocking.

3. Electronic motor overload relay.

4. Automatic restart after power outage, drive fault or external fault, with drive in automatic mode. The circuit shall allow the user to select up to (10) restart attempts as well as the dwell time between attempts. The reset time between fault occurrences shall also be selectable. All settings shall be via the membrane command center.

5. Door-mounted LED display for digital indication of:

   a. Frequency output
   b. Voltage output
   c. Current output
   d. First fault indication
   e. Pump Speed (RPM)

6. Relay contacts for remote indication of drive fault and motor finning.

7. Three critical frequency avoidance bands, field programmable via the membrane command center. Each critical frequency avoidance band shall have a bandwidth adjustable via keypad entry of up to 10 Hz.

8. Three programmable preset speeds which shall force the AFC to a preset speed upon a user contract closure.

9. Isolated process follower to enable VFC to follow a 4-20 mA signal.

10. The AFC shall have the capability to ride through power dips up to 500 msec without a controller trip depending on load and operating condition.

11. Line reactor to minimize line surges, line notching, and voltage distortions. Line reactor shall be installed upstream of the drive.

I. Manual bypass-to-line with magnetic contactors to transfer motor from the variable frequency controller to full speed operation on utility supplied input power while the motor is at any speed. Two motor contactors, electrically interlocked shall be utilized, one contactor between the controller output and the motor and the other between the bypass power line and the motor, providing across-the-line starting.

J. Motor protection per National Electrical Code shall be provided in both the "controller" mode and the "bypass" mode by a motor overload relay. The 115 volt A-C relay control logic, allowing common start/stop commands in the "controller" mode and the "bypass" mode shall also be included within the enclosure.

K. The bypass shall include a door interlocked, main power input circuit breaker providing positive shutdown of all power to both the bypass circuitry and the VFC. The bypass circuit shall also include a second input disconnect to the VFC. This disconnect shall provide the ability to safely trouble shoot and test the controller, both energized and de-energized, while operating the bypass mode.

L. The VFC and all components shall be supplied within a single NEMA 4X enclosure, and shall be U.L. Listed as a single unit. Furnish all components necessary to provide a minimum lead length between motor and drive of 400 ft. The VFC shall not generate damaging transistor pulses greater than the limits set by NEMA MG-1 at 400 Ft lead length.

M. The VFC manufacturer shall maintain and staff nationwide service centers. These service engineers shall be employed by the manufacturer and provide start-up service including physical inspection of drive and connecting wiring and final adjustments to meet specified performance requirements.

N. The VFC shall carry a full parts and labor warranty for two years from date of Owner acceptance of the building.

O. The variable frequency drive shall be ABB, or approved equal of Accutrol, Cutler Hammer, Graham, York, Baldor, AC Tech, Trane, Emerson, Danfos, Yaskawa, Toshiba, or as approved equal.

P. The variable frequency drive manufacturer shall coordinate with the ATC contractor and provide all necessary devices whether optional or not to perform complete and automatic operation as described in the sequence of operation. All safeties, including freezestats, duct smoke detectors, and high static pressure sensors shall be enabled when variable speed drives are in manual or bypass.

Q. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display VFC status and alarms. 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; protocols accessible via the communications ports.

R. Variable frequency drives shall be carefully selected for the duty required. Variable frequency drives shall be specifically designed for the specified equipment to be controlled. Fan drives shall be selected for fans.

2.6. SCBA (SELF CONTAINED BREATHING APPARATUS)

A. Furnish and install self-contained breathing apparatus SCB AFC international, devices where required by ASHRAE 15, and as indicated on Contract Drawings. SCBA shall be manufactured by Genesis, MSA, Thermal Gas or approved equal.

B. Description: Open-circuit, pressure-demand, compressed-air SCBA includes completely assembled, portable, self-contained devices designed for hazardous breathing environment application.

C. Face Piece: EPDM construction material, one-size-fits-all with double-sealing edge, stainless-steel speaking diaphragm and lens retainer, five adjustable straps to hold face piece to head (two straps on each side and one on top), exhalation valve in mask, close-fitting nose piece to ensure no CO2 build-up, and perspiration drain to avoid skin irritation and to prevent eyepiece, spectacle, and lens fogging.

D. Backplate: Orthopedically designed of lightweight aluminum.

E. Harness and Carrier Assembly: Large triangular back pad, backplate, and adjustable waist and shoulders straps. Modular in design, detachable components, and easy to clean and maintain. Shoulder straps are padded with flame-resistant material and reinforced with stainless-steel cable and attached with T-nuts, washers, and screws; rivets are not permitted.

F. Air Cylinder: 30-minute, low-pressure, air-supply-loaded fiberglass cylinders fitted with quick-fill assembly for refilling and air transfer.

G. Wall-Mounted Case: Leakproof, corrosion-resistant, tough, plastic case.

H. Comply with requirements in 42 CFR 84.

I. SCBA: Tested and certified by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration according to 42 CFR 84, Subpart H.

J. Training: Provide a "how-to-use" SCBA video that details exact operating procedures of equipment.

2.7. BASE MOUNTED PUMP - END SUCTION

A. Furnish and install base mounted centrifugal end suction pump to circulate hydronic water to the cooling tower/chiller. Pumps shall have sizes and capacities as indicated on the drawings.

B. All pumps shall be suitable for the service and temperatures designated and shall conform to the following requirements. Each pump shall have a factory installed seal flushing line running from the seal area to the pump suction to insure removal of trapped air from the seal area, removal of sediment, and cooling of the seal to extend seal life. Provide and install Cuno five (5) micron filters in seal flushing lines. Provide two (2) sets of cartridges for each side - stream filter.

C. Pumps shall be cast iron bronze fitted and shall be suitable for up to 175 psi working pressure and up to 250 degrees F water temperature. Pumps shall have center-line discharge for positive venting and flanged bodies. Pumps shall incorporate a grease lubrication system and be so designed that the bearing assembly can be removed in one piece. A water slinger shall be provided between the mechanical seal and bearing areas. Pump shafts shall be stainless steel with a cupro-nickel sleeve, and be coupled to the motor shaft by a noiseless, non-metallic coupler with guard. Impellers shall be one piece cast bronze, dynamically balanced. Motors shall be 1750 rpm.

D. Pumps shall be designed so that they shall not overload at low heads and shall not develop excessive pressure under throttled flow conditions or overload motor anywhere on the operating curve. Operating performance curves shall be submitted for approval. Provide gauge tappings on each pump flange. Furnish dust caps at all oil fill tubes. Pump motors shall be non-overloading throughout the range of the curves.

E. Units shall be provided with motors of not less than the horsepower indicated, suitable for the service and available electrical characteristics. Units shall be controlled as hereinafter specified. After installation and prior to operation, each pump shall be aligned. Motors shall be as specified hereinbefore.

F. Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.

G. Impeller: Bronze, fully enclosed, keyed to shaft.

H. Baseplate: Cast iron or fabricated steel with integral drain rim.

I. Pumps shall be primed and painted in baked enamel, rust resistant paint.

J. Pump Seals: EPR/Silicon Carbide/Silicon Carbide.

K. Electrical characteristics shall be as scheduled on the contract drawings. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA-70.

L. Pumps shall be FE series as manufactured by Taco, 2000 Series by Allis Chalmers, Aurora, Bell & Gossett, PACO, Armstrong, Patterson, or as approved equal.

PART 3. EXECUTION

3.1. EXAMINATION

A. Verify all dimensions by field measurements. Verify that all equipment may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.

B. Verify structure, mounting supports and membrane installations are completed to the proper point to allow installation of roof mounted equipment, where applicable.

C. Examine rough-in requirements for all piping systems to verify actual locations of piping connections prior to installation.

D. Verify that electrical work installation is in accordance with manufacture's submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until electrical work is acceptable to equipment installer. Coordinate sizes of all thermal overloads with Division 26.

E. Do not proceed until unsatisfactory conditions have been corrected.

F. Provide wiring diagrams of all equipment as specified in Division 23 Section 23 05 00 Common Work Results for HVAC.

3.2. GENERAL INSTALLATION REQUIREMENTS

A. Install all equipment in accordance with manufacturer's installation instructions, in accordance with state and local code requirements, and in accordance with the contract drawings. Install all equipment plumb and level, to tolerances as required by the manufacturer of each item of equipment. Maintain manufacturer recommended clearances around and over all equipment.

B. Coordinate vibration isolation requirements with all equipment in accordance with Division 23 Section 23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment.

C. Coordinate all electrical requirements with Division 26.

D. Coordinate all indoor equipment pad locations and sizes with approved shop drawing submittals. Coordinate equipment pad locations and sizes with the Concrete Contractor or General Contractor. Furnish anchor bolts which are to be inserted in concrete pads to concrete installer.

E. Verify piping arrangements of all equipment with the contract drawings. Piping details shall be strictly adhered to concerning valves, fittings, components, etc. At coils, where a rebuildable and repairable autoflow valve is installed in the line without the need for draining or shutting of the water, the same may be utilized as the isolation valve and additional shut-off valve is not required.

F. Connect all equipment, devices and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including

screws and bolts, according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.

G. Testing: After installing HVAC equipment, devices and components and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

H. Remove and replace malfunctioning units with new units and retest.

I. All mechanical penetrations or terminations in exterior walls shall be flashed and caulked watertight.

J. Arrange for equipment such as fans and starters to be shipped to project in modules where space constraints require the same. Field erect components as required.

3.3. FIELD QUALITY CONTROL

A. Where indicated provide the services of a factory authorized service representative to examine the field assembly of components, installation, piping, electrical connections, controls, and clearances. Submit factory start-up check list to Engineer for information purposes. Testing and balancing work shall not commence until start-up reports have been completed, reviewed by Engineer, and forwarded to Testing and Balancing Agency.

B. Where factory start-up of equipment is not specified, provide field start-up by qualified technician to examine the field assembly of components, installation, piping, electrical connections, controls and clearances. Record equipment manufacturer’s standard start-up information and submit to Engineer for review. Testing and balancing work shall not commence until start-up reports have been completed, reviewed by Engineer, and forwarded to Testing and Balancing Agency.

C. Charge all refrigerant systems with refrigerant and oil and test for leaks. Repair leaks and replace lost refrigerant and oil.

D. Fill all hydronic systems with water after flushing and test for leaks. Repair leaks and replace lost water. Coordinate with Owner’s water treatment contractor.

E. Submit to Engineer a written table of all relief valve and make-up water valve settings for each system. Provide an additional copy in the Operations and Maintenance Manuals.

F. Verify proper motor sizes, voltages, thermal overloads, nameplate data, etc. All equipment voltages and current shall be recorded to insure that motors are operating below their service factors. Test and Balance Engineer shall record electrical data before continuous or permanent operation.

3.4. DEMONSTRATION

A. Provide the services of a factory authorized service representative to provide start-up and to demonstrate and train the Owner's maintenance personnel.

B. Place equipment into operation and adjust controls and safeties. Replace damaged or malfunctioning components and controls.

C. Training:

1. Train the Owner's maintenance personnel on start-up and shut-down procedures, trouble shooting procedures, lubrication, servicing procedures and preventative maintenance schedules/procedures. Review with the Owner's personnel, the contents of the operation and maintenance data specified in Division 23 Section 23 05 00 Common Work Results for HVAC.

2. Submit operation and maintenance data as soon as possible prior to project close-out. Operations and maintenance data shall be submitted to the Owner for review and comment prior to submission to the Engineer.

3. Schedule training with the Owner through the Architect and/or Engineer with at least seven (7) days prior notice.

3.5. CLEANING

A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.

B. Clean fan and equipment interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils' entering air face.

3.6. CHILLER INSTALLATION REQUIREMENTS

A. Supply initial charge of refrigerant and oil as required.

B. Install chiller components according to manufacturer's written instructions.

C. Maintain manufacturer's recommended clearances for service and maintenance.

D. Install piping connections maintaining clearances for service and maintenance of chillers.

E. Manufacturer's Field Service: Provide services of a factory authorized service representative to supervise field assembly of components and installation of chillers, including piping and electrical connections, and to report results in writing.

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

F. All chiller start-up services and diagnostic testing shall be completed prior to cooling season (April 15th).

G. Provide services of a factory trained service technician to start refurbished chiller and train Owner on the chiller operation.

H. Interlock chiller with automatic temperature control system. Coordinate requirements

with automatic temperature control contactor.

I. Coordinate start-up of chiller with Owner. Start-up of chiller shall be provided by Contractor.

J. Install, wire, and interlock fluid flow switches. Interface with automatic temperature control system.

K. Test both flow switches.

L. Install new manufactured supplied strainer basket in the chilled water return line.

M. Install refrigerant monitoring system and all interlock wiring/controls.

N. Install SCBA where indicated on the Contract Drawings.

3.7. FAN INSTALLATION REQUIREMENTS.

A. Install fans with resilient mounting and flexible electrical leads.

B. Install flexible connections and vibration isolators as specified in Division 23 Section 23 05 00 Common Work Results for HVAC and Division 23 Section 23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment. Ensure metal band of connectors are parallel with minimum one inch flex between ductwork and fan while running.

C. Provide safety screens/guards on all fans and permanently mount after final testing and balancing.

D. Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fans have been test run under operation.

E. Provide sheave required for final air balance.

F. Install fans according to manufacturer's written instructions.

G. Adjust damper linkages for proper damper operation.

H. Adjust belt tension.

I. Lubricate bearings.

J. Replace fan and motor pulleys and belts as required to achieve design conditions.

3.8. HEAT REJECTION EQUIPMENT INSTALLATION REQUIREMENTS

A. Maintain recommended clearances for service and maintenance.

B. Manufacturers Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

C. Cooling tower start-up and testing shall be completed prior to cooling season (April 15th).

Coordinate start-up of cooling tower for cooling season with Owner. Start-up of cooling tower shall be provided by Contractor.

D. Adjust water-level control for proper operating level.

E. After completing system refurbishment, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt and construction debris, and repair damaged finishes including chips, scratches and abrasions.

F. Obtain wet-bulb, condenser-size, and performance selection tables from manufacturer.

G. Lubricate bearings on fans and shaft as recommended by manufacturer.

H. Ensure fan wheels rotate in correct direction without vibration or binding.

I. Start refurbished cooling tower. Follow manufacturers written starting procedures.

J. Check water level in cooling tower basin.

K. Check operation of cooling tower basin, make-up line, float valve, and low water cut-off controlling device.

L. Wire all chemical treatment panel, bleed-off valves, water level controls, pump interlocks, fan interlocks, low water cut-offs, and control panel under Division 23.

M. Maintain and verify all chemical treatment piping from chemical treatment panel to evaporative condenser.

3.9. HVAC PUMP INSTALLATION REQUIREMENTS

A. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.

B. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches (102 mm) and over.

C. Provide drains for bases and seals, piped to and discharging into floor drains.

D. Check, align, and certify alignment of base mounted pumps prior to start-up. Prior to starting pumps, the alignment of the pumps and their motors or other drivers shall be carefully checked. Alignment should be checked for both offset and angularity. Alignment by means of an Ames dial, Laser or equivalent shall be accomplished for all pumps. Alignment by straight edge across the pump couplings shall not be acceptable.

E. Install base mounted pumps on concrete housekeeping pads, with anchor bolts, set and level, and grout in place. See Division 23 Section 23 05 48 Vibration Controls for HVAC, Plumbing and Fire Protection Equipment for inertia pad requirements. After alignment is correct, tighten foundation bolts evenly but not too firmly, completely fill baseplate with non shrink, non metallic grout while metal blocks and shims or wedges are

in place. After grout has cured, fully tighten foundation bolts.

F. Lubricate pumps before start-up.

G. Provide side-stream filtration system for base mounted pumps. Install across pump with flow from pump discharge to pump suction from pump tappings. Install flow indicator, filter housing with cartridge filter, shut-off valves, and flow control valves. Install 30 micron filter for start-up and 5 micron filter for system operation.

H. Install pumps according to manufacturer's written instructions.

1. Install pumps according to HI 1.1 1.5, Centrifugal Pumps for Nomenclature, Definitions, Application and Operation.

I. Install pumps to provide access for periodic maintenance, including removing motors, impellers, couplings, and accessories.

J. Set base mounted pumps on concrete foundation. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.

1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1 1/2 inches between pump base and foundation for grouting.

2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

3.10. REFURBISHMENT OF EXISTING WATER COOLED CHILLER REQUIREMENTS

A. Lock out / tag out all energy sources.

B. Disconnect and remove old starter.

C. Furnish and install new power wiring between new starter and existing chiller.

D. Cap off all condenser coolant lines for old starter.

E. Furnish and install one (1) new motor terminal box for existing chiller motor.

F. Furnish and install control wiring and control transformers between new starter and chiller control panel.

G. Furnish and install all control panel components needed to adapt to new starter.

H. As a minimum the components shall include CM-2 current module, Diode Bridge, Adjustable resistor assembly, and CT Kit.

I. Configure all control panel parameters for new starter.

J. Calibrate current modules.

K. Refurbish chiller motor.

L. Provide and set up all rigging needed to remove motor from chiller.

M. Disconnect motor coupling.

N. Rig motor to ground.

O. Provide crane services to rig motor in/out of mechanical room.

P. Reinstall motor after refurbish.

Q. Reconnect motor coupling.

R. Perform incoming visual inspection and document any concerns.

S. Perform incoming electrical testing and document all findings.

T. Disassembly of motor – perform incoming mechanical inspection.

U. Verify all fits and surfaces (MIC) – document results.

V. Steam clean and bake stator.

W. Varnish treat and bake stator.

X. Clean and inspect all parts and components.

Y. Perform growler/inductance test rotor for open and/or broken bars.

Z. Check rotor body/shaft for straightness and concentricity.

AA. Dynamically stack balance rotating assembly.

BB. Furnish and install new bearings.

CC. Re-assemble motor – perform quality control inspection (document in writing).

DD. Post assembly testing – record final vibration readings.

EE. Paint motor – deliver to site for installation under this project.

FF. Perform eddy current testing for heat exchangers and submit test results.

GG. Provide all new control sensors, devices and wiring. Refer to Controls drawings and specifications (section 230900 Instrumentation and Controls of HVAC Equipment).

HH. Perform full system service and start-up as recommended by manufacturer.

II. Provide factory commissioning for re-furbished chiller.

JJ. Program chiller parameters as required, perform factory authorized startup, and owner's training.

KK. Perform system integration of chiller packaged controls with building automatic temperature controls system.

LL. Dispose of all work-related debris into dumpster.

3.11. REFURBISHMENT OF EXISTING COOLING TOWER REQUIREMENTS

A. Prior to our arrival, have onsite personnel isolate and drain down the cooling tower for the duration of the work.

B. Check in with onsite personnel upon arrival on site to gain access to the cooling tower.

C. Lock Out/Tag Out fan motor and sump heaters at disconnects.

D. Furnish and set into place necessary expansion pipe plugs into the bottom connection suction line to prohibit any debris from entering into piping.

E. Remove existing fill media from tower and dispose of in temporary jobsite dumpster.

1. NOTE: Due to the large amounts of debris created during the demolition process, a temporary jobsite dumpster will need to be placed on site.

F. With the aid of a pressure washer, wash down all interior sections of the cooling tower of any remaining light scale buildups, debris, etc.

G. While the existing fill media is removed from the cooling tower, access all accessible sheet metal surfaces on side casing panels and cold water sump basin panels and clean the same, in areas where fill media was present, perform the following procedures:

1. Scrape clean all accessible seams of any old caulking, migrated butyl strip sealer tape, and light debris deposits.

2. To areas where butyl strip sealer tape has migrated completely from the sheet metal seam, furnish and install new butyl strip sealer tape into the seam.

3. Apply a bead of polyurethane caulking to the sheet metal seams.

H. Clean entire cold water sump basin of all accumulated debris and dispose of in dumpster.

I. To all the remaining accessible sheet metal seams in the stainless steel cold water sump basin, scrape clean of any old caulking, debris, or butyl strip sealer tape.

J. Wipe down sheet metal seam surfaces with a degreasing solvent to prepare for application of new caulking.

K. Apply a bead of marine grade caulking to the prepared surfaces and allow time to cure.

L. Furnish and install all new bottom supported PVC Crossflow Herringbone Bundled Fill Media, as manufactured by Brentwood Industries©, complete with Integral Inlet Louvers

and Integral Drift Eliminators.

1. New Bundled Fill Media will be installed onto all new PVC support system at an elevated position 4”-5” off cold water sump basin floor to necessitate access for future cleanings of the cold water sump basins.

M. Remove earlier positioned expansion plugs out of all bottom piping connections and transport offsite.

N. Remove Lock Out/Tag Outs from disconnects.

O. With the assistance from onsite personnel, refill the cooling tower cold water sump basin and return tower into operation. Check over tower for any leaks and address as required.

P. Test operation of cooling tower and all controls. Submit start-up report.

Q. Clean up job site of all work related debris and dispose of into temporary dumpster.

R. Stainless steel cold water sump basin resealing with waterproof membrane application.

1. Once the existing fill media has been removed from the tower, perform the following procedures to the accessible stainless steel cold water sump basin sheet metal seams:

a. To all accessible interior sheet metal seams in the cold water sump basin, scrape clean all accessible sheet metal surfaces around areas of the sheet metal seams of any caulking or migrated butyl strip sealer tape.

S. Wipe down prepared surfaces with a xylene solvent to prepare the seam surfaces for the application of the new CIM Bonding Agent® from CIM Industries Inc. per manufacturer’s specifications.

T. Apply a bead of marine grade caulking to all accessible stainless steel sheet metal seams

1. NOTE: Cure time for marine grade caulking takes (12-24) hours, dependent on air temperatures.

U. Apply a band of CIM Bonding Agent® 4” wide over all prepared accessible seams by applicator.

V. To the accessible interior SST cold water sump seams, apply a continuous, seamless, positively bonded, elastomeric waterproof urethane membrane at a minimum wet film thickness of 60-mils.

1. NOTE: Cure time for waterproof urethane membrane is (12-24) hours from application time.

W. Clean up job site of all work related debris and dispose of offsite.

X. Gearbox Replacement.

1. Lock Out/Tag Out fan motor at disconnect.

2. Remove fan guard and set aside for later reinstallation.

3. Remove prop fan assemble from output shaft of the existing gearbox and set aside for later reinstallation.

4. Remove hardware from input shaft drive coupling on gearbox.

5. Remove mounting hardware from gearbox and dispose of.

6. Rig and remove aged gearbox from mechanical support and transport offsite for disposal of.

7. Clean mounting plate of any residual oil and debris in preparation for installation of new gearbox.

8. Furnish, rig, and install one (1) new OEM Marley Geareducer™ Series 1800 right-angle, single reduction gearbox, complete with new input shaft drive shaft coupling, into place on mounting plate on mechanical support.

9. Secure new gearbox into place with all new mounting hardware.

10. Reinstall earlier removed prop fan assemble back onto output shaft of newly installed gearbox.

11. Reinstall earlier removed fan guard back into place and secure.

12. Remove Lock Out/Tag Out from disconnect.

13. Energize fan motor and check for proper rotation and operation of newly installed gearbox.

14. Ensure proper fan clearance around fan cowl.

15. Once initial installation is complete, with the assistance from a reputable balance company, perform Laser Alignment and Balancing of newly installed gearbox with the drive shaft and reinstalled prop fan assemble.

16. Clean up job site of all work related debris and dispose of offsite.

Y. Fan Motor Replacement

1. Check in with onsite personnel upon arrival for access to the cooling tower unit.

2. Lock Out/Tag Out fan motor at disconnect.

3. Disconnect incoming electrical connections at motor junction box.

4. Remove hardware from output shaft drive coupling on motor.

5. Remove mounting hardware from motor and dispose of.

6. Rig and remove aged motor from mechanical support and transport offsite for disposal of.

7. Furnish, rig, and install one (1) new 25 HP, 208 Volt, 3 Phase, 60 Hz, 1800 RPM, Premium

8. High Efficiency Inverter Duty, TEAO motor complete with new output shaft drive shaft coupling, into place on mounting plate on mechanical support.

9. Secure new motor into place with all new stainless steel mounting hardware.

10. Connect to new Variable Frequency Drive and new incoming electrical connections into new motor junction box.

11. Install new Variable Frequency Drive (VFD) with bypass option in a NEMA 4X enclosure. VFD will be mounted outside adjacent to tower. Refer to separate specifications for variable frequency drive. All wiring/conduit to VFD and from VFD to fan motor shall be completed as part of the refurbishment.

12. Program VFD parameters as required, perform factory authorized startup, and owner's training.

13. Remove Lock Out/Tag Out from disconnect.

14. Energize fan motor and check for proper rotation and operation of newly installed gearbox.

15. Ensure proper fan clearance around fan cowl.

16. Clean up job site of all work related debris and dispose of offsite.

Z. City Water Makeup Float Assembly Replacement

1. Prior to our arrival, have onsite personnel isolate and drain down the cooling tower for the duration of the work.

2. Check in with onsite personnel upon arrival on site to gain access to the cooling tower.

3. Lock Out/Tag Out fan motor and sump heaters at disconnects.

4. Remove existing city water mechanical makeup float assembly from connection into cooling tower and dispose of.

5. Furnish and install one (1) new City Water Mechanical Makeup Float assembly into place and set float ball to water level setting.

6. Remove Lock Out/Tag Out from disconnects.

7. With the assistance from onsite personnel, refill the cooling tower and check from proper settings on mechanical float assembly. Make necessary adjustments

as needed.

8. Clean up job site of all work related debris and dispose of offsite.

AA. Custom Internal Walkway Installation

1. Prior to our arrival, have onsite personnel isolate and drain down the cooling tower for the duration of the work.

2. Check in with onsite personnel upon arrival on site to gain access to the cooling tower.

3. Lock Out/Tag Out fan motor and sump heaters at disconnects.

4. Furnish and install all materials and components for one (1) custom built Internal Walkway, stretching from access door to access door, to allow for access into the cooling tower unit without the need for draining down the cold water sump basin.

5. Any materials that are neither galvanized or aluminum and all welds will be coated with a zinc rich, cold galvanizing compound.

6. Clean up job site of all work related debris and dispose of offsite.

END OF SECTION

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HVAC INSULATION
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SECTION 23 07 00
HVAC INSULATION

PART 1. GENERAL

1.1. REFERENCE

A. The Conditions of the Contract and other General Requirements apply to the work specified in this Section. All work under this Section shall be subject to the requirements of Division 23 Section 23 05 00 Common Work Results for HVAC.

B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section

1.2. DESCRIPTION

A. All piping, ductwork, and equipment installed under this Contract shall be covered as specified.

1.3. SCOPE

A. The work covered by this specification consists of furnishing all labor, equipment, materials and accessories, and performing all operations required, for the correct fabrication and installation of thermal insulation applied to all piping, equipment, and duct systems, in accordance with applicable project specifications and drawings, subject to the terms and conditions of the contract.

1.4. STANDARDS

A. Thermal insulation materials shall meet the property requirements of one or more of the following specifications as applicable to the specific product or use:

1. American Society for Testing of Materials Specifications:

   a. ASTM C 547, "Standard Specification for Mineral Fiber Preformed Pipe Insulation".
   b. ASTM C 533, "Standard Specification for Calcium Silicate Pipe & Block Insulation".
   c. ASTM C 55, "Standard Specification for Mineral Fiber Blanket and Felt Insulation".
   d. ASTM E 96, “Standard Test Methods for Water Vapor Transmission of Material”.
   e. ASTM C 585, "Recommended Practice for Inner and Outer Diameters of Rigid Pipe Insulation for Nominal Sizes of Pipe and Tubing (NPS System)".
   f. ASTM C 612, "Standard Specification for Mineral Fiber Block and Board Thermal Insulation".
   g. ASTM C 1136, "Standard Specification for Barrier Material, Vapor, "Type 1 or 2 (Jacket only).

2. ASHRAE 90.1 "Energy efficient design of new buildings except low-rise residential buildings", latest edition.

3. International Energy Conservation Code, latest edition.

B. Insulation materials, including all weather and vapor barrier materials, closures, hangers, supports, fitting covers, and other accessories, shall be furnished and installed in strict accordance with project drawings, plans, and specifications.

1.5. SYSTEM PERFORMANCE

A. Insulation materials furnished and installed hereunder should meet the minimum economic insulation thickness requirements of the North American Insulation Manufacturers' Association (NAIMA) (formerly known as TIMA), to ensure cost-effective energy conservation performance. Alternatively, materials should meet the minimum thickness requirements of National Voluntary Consensus Standard 90.1, (latest edition) and "Energy Efficient Design of New Buildings," of the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE), latest edition. However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor. As minimum, all insulation thicknesses shall be as hereinafter specified.

B. Insulation materials furnished and installed hereunder shall meet the fire hazard requirements of any one of the following specifications:

1. American Society for Testing of Materials ASTM E 84

2. Underwriters' Laboratories, Inc. UL 723

3. National Fire Protection Association NFPA 255

4. ASTM E 96, “Standard Test Methods for Water Vapor Transmission of Materials”.

C. Calcium silicate products shall include a visual identification system to permit positive field determination of their asbestos-free characteristics.

1.6. QUALITY ASSURANCE

A. Insulation materials and accessories furnished and installed hereunder shall, where required, be accompanied by manufacturers' current submittal or data sheets showing compliance with applicable specifications listed in Section 1.4 above.

B. Insulation materials and accessories shall be installed in a workmanlike manner by skilled and experienced workers who are regularly engaged in commercial insulation work.

1.7. DELIVERY AND STORAGE OF MATERIALS

A. All of the insulation materials and accessories covered by this specification shall be delivered to the job site and stored in a safe, dry place with appropriate labels and/or other product identification.

B. The Contractor shall use whatever means are necessary to protect the insulation materials

and accessories before, during, and after installation. No insulation material shall be installed that has become damaged in any way. The Contractor shall also use all means necessary to protect work and materials installed by other trades.

C. If any insulation material has become wet because of transit or job site exposure to moisture or water, the Contractor shall not install such material, and shall remove it from the job site. An exception may be allowed in cases where the Contractor is able to demonstrate that wet insulation when fully dried out (either before installation, or afterward following exposure to system operating temperatures) will provide installed performance that is equivalent in all respects to new, completely dry insulation. In such cases, consult the insulation manufacturer in writing for technical assistance.

D. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements. Protect all insulation from water, construction traffic, dirt, chemical and mechanical damage.

1.8. ALTERNATES

A. Refer to Division 01 Section 01 23 00 “Alternates” for description of work under this section affected by alternates.

PART 2. PRODUCTS

2.1. GENERAL

A. All materials to be insulated shall be thoroughly cleaned, after completion of successful tests, and shall be covered as specified below. Fiberglass insulation shall be Owens-Corning, Manville, Armstrong, or P.P.G, or as approved equal.

2.2. PIPE INSULATION MATERIALS

A. Unless otherwise noted, insulation shall be one piece or half sectional molded fibrous glass with "K" rating of .23 at 75 degrees Fahrenheit mean temperature, for service temperatures between -60 degrees Fahrenheit and +450 degrees Fahrenheit with all service poly-encapsulated jacket. Pipe insulation shall be fiberglass ASJMax SSL II with double closure system as manufactured by Owens Corning, Johns Manville, Knauf or approved equal.

B. Unless otherwise noted, pipe insulation jacket shall be factory-applied vinyl coated, embossed and reinforced vapor barrier laminate, with a perm rating of not more than 0.02 perms. All hot and cold, concealed and exposed butt strips shall be of the same material as the jacket. Jacket and butt strips shall be sealed with field-applied Foster 85-20/85-60 or Childers CP-82 (5 gal cans only) adhesive. Jacket and butt strips shall be off-white color and shall be equivalent to Owens-Corning Fiberglass 25-ASJ.

C. Indoor chilled water pipe insulation shall be ASJ Max with SSL-II closure system pipe insulation as manufactured by Owens Corning or approved equal. Pipe insulation shall be composed of heavy density fiberglass insulation with an organic binder. The insulation shall include a white, factory jacketed, resilient, tough, soil resistant polymer facing that matches standard PVC fitting covers. Furnish all accessories and matching butt joints sealing tape for system closure. Insulation shall be suitable for operating temperatures between 32 degrees Fahrenheit and 220 degrees Fahrenheit. Flame spread rating of 25 or

less, and smoke development rating of 50 or less to comply with building codes for installation in return air plenums. The maximum thermal conductivity (K-value) at a mean temperature of 50 shall be .22 BTU-in/hr-Ft2-degrees Fahrenheit.

D. For fittings on all piping, valves and flanges, apply fiberglass molded or segmented insulation equal in thickness to the adjoining insulation and securely fasten in place using wire. Cold piping: Apply a tack coat of vapor barrier coating and reinforcing mesh. After ½ hour, apply second coat of same vapor barrier coating, UL labeled, Type C, for cold water piping, Hot piping Type H for hot water piping: Apply tack of breather mastic. Wrap fitting with fiberglass reinforcing cloth overlapping adjoining sections of pipe insulation by 2-inches. Apply a second coat of breather mastic over the reinforcing cloth, working it to a smooth finish.

1. Vapor Barrier Coating: Foster 30-65; Childers CP-34 or Vimasco 749. Permeanie shall be 0.03 perms or less at 45 mils dry as test by ASTM E96.

2. Breather mastic: Foster 46-50; Childers CP-10/11 or Vimasco WC-5

3. Reinforcing Mesh: Foster Mast a Fab; Childers Chil Glas #10 or Vimasco Elastafab

E. All pipe insulation, jackets, or facings, and adhesives used to adhere jacket or facing to the insulation, including fittings and butt strips, shall have non-combustible fire and smoke hazard system rating and label as tested by ASTM E-84, NFPA 225, and UL 73, not exceeding Flame Spread 25, Fuel Contributed 50, Smoke Developed 50. Accessories such as adhesives, mastic cements, tapes and cloth for fittings shall have the same ratings as listed above. All products or their shipping cartons shall bear the Underwriter's label indicating that flame and smoke ratings do not exceed the above criteria.

F. For piping having a vapor barrier insulation and for all insulated piping requiring supports, hangers and supports shall be installed outside the insulation. Wherever hangers and supports are installed outside the insulation, pipe insulation protecting shields shall be provided. Where insulation is a load bearing material, of sufficient strength to support the weight of the piping, pipe shields one-third the circumference of the insulation and of a length not less than three times the diameter of the insulation (maximum length 24-inches) shall be provided. Insulation of 7-1/4 pound or greater density will be considered as load bearing for pipe sizes up to and including 2-inches. Where insulation is not of sufficient strength to support the weight of the piping, a half section of high density fiberglass or foam inserts, shall be provided. Vapor barrier and finish shall be applied as required to match adjoining insulation. In addition, shields shall be furnished as specified above.

G. All disturbed piping insulation in existing areas shall be re-insulated with insulation type, density, and thickness as specified for new piping. Insulation damaged due to new work and demolition only shall be replaced unless otherwise noted.

H. On cold systems such as chilled water piping, dual temperature piping, and vapor barrier performance is extremely important. All penetrations and seams of the ASJ and exposed ends of insulation must be sealed with vapor barrier coating. The ASJ must be protected with either a coating or a suitable vapor retarding outer jacket. Vapor seals at butt joints shall be applied at every fourth pipe section joint and at each fitting to provide isolation of water incursion. Vapor Barrier Coating: Foster 30-65; Childers CP-34 or Vimasco 749.

Permeance shall be 0.03 perms or less at 45 mils dry as test by ASTM E96.

I. Fittings and valves shall be insulated with pre-formed fiberglass fittings, fabricated sections of fiberglass pipe insulation, Fiberglass pipe and tank insulation, Fiberglass blanket insulation, or insulating cement. Thickness shall be equal to adjacent pipe insulation. Finish shall be with pre-formed PVC fitting covers or as otherwise specified on contract drawings. Where applicable, Victaulic PVC fitting valve and coupling covers shall be utilized. Victaulic PVC covers shall be installed with matching pipe insulation jacketing material, vinyl tape solvent weld adhesive and appropriate fasteners.

1. Flanges, couplings and valve bonnets shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as on the main pipe section. An oversized insulation section shall be used to form a collar between the two insulation sections with low density blanket insulation being used to fill gaps. Jacketing shall match that used on straight pipe sections. Rough cut ends shall be coated with a suitable weather or vapor-resistant mastic as dictated by the system location and service. Finish valve installation with a Tyvac jacket with ends that secure to adjacent piping.

2. On hot systems where fittings are to be left exposed, insulation ends should be beveled away from bolts for easy access.

3. On cold systems, particular care must be given to vapor sealing the fitting cover or finish to the pipe insulation vapor barrier. All valve stems must be sealed with caulking which allows free movement of the stem but provides a seal against moisture incursion. All gauge and thermometer penetrations and extensions shall be correctly sealed and insulated to prevent surface condensation. Install oversized hangers to prevent penetrations of pipe insulation vapor barrier.

J. All piping shall be supported in such a manner that neither the insulation or the vapor/weather barrier is compromised by the hanger or the effects of the hanger. In all cases, hanger spacing must be such that the circumferential joint may be made outside the hanger. On cold systems, vapor barrier must be continuous, including material covered by the hanger saddle.

1. Piping systems 3-inches (7.5cm) in diameter or less, insulated with Fiberglass insulation, may be supported by placing saddles of the proper length and spacing, as designated in Owens-Corning Pub. 1-IN-12534, under the insulation. Hangers saddles shall be minimum 16 gauge with a saddle arc of 120 degrees minimum.

2. For hot or cold piping systems larger than 3-inches (7.5 cm) in diameter, operating at temperatures less than +200 degrees F (93 degrees C) and insulated with fiber glass, high density inserts such as foam or wood blocks with sufficient compressive strength shall be used to support the weight of the piping system. At temperatures exceeding +_200 degrees F (93 degrees C), Owens-Corning Pink Calcium Silicate, IIG, or approved equal pipe insulation shall be used for high density inserts.

3. Owens-Corning Pink Calcium Silicate pipe insulation may be used to support the entire weight of the piping system provided the hanger saddle is designed so the maximum compressive load does not exceed 100 psi (7kg/cm).

4. Where pipe shoes and roller supports are required, insulation shall be inserted in the pipe shoe to minimize pipe heat loss. Where possible, the pipe shoe shall be sized to be flush with the outer pipe insulation diameter.

5. Thermal expansion and contraction of the piping and insulation system shall generally be taken care of by utilizing double layers of insulation and staggering both longitudinal and circumferential joints. Where long runs are encountered, expansion joints may be required where single layers of insulation are being used and should be so noted on the contract drawings.

6. On vertical runs, insulation support rings shall be used.

2.3. PIPING INSULATION THICKNESSES SCHEDULE

A. All piping shall be insulated with pipe insulation of the thicknesses indicted below:

PIPING INSULATION THICKNESS SCHEDULE SERVICES	THICKNESS
New Chilled Water Piping 2 ½-inches & Larger	2-inch thickness
New Chilled Water Piping 2-inches & Smaller	2-inch thickness
Chemical Treatment Piping	2-inch thickness
New Condenser Water Piping	1 ½-inch thickness

2.4. EQUIPMENT INSULATION MATERIALS AND THICKNESSES

A. The following equipment shall be insulated with Fiberglass Rigid Board Insulation or Foam Plastic Insulation:

1. Condenser Water Pump Volutes and Strainers.

B. Insulation for cold surfaces shall be 1-1/2-inch thickness, 6 lb. density, 705 FRK with a "K" rating of .23 at 75 degrees F mean temperature. Insulation for hot surfaces except as otherwise noted shall be 1-1/2-inch thickness, 6 lb. density, 705 with a "K" rating of .23 at 75 degrees F mean temperature. Insulation shall be applied with staggered joints firmly butted and joined. The insulation shall be held in place by steel bands. Bands shall be 1-inch by 25 gauge galvanized steel spaced on not over 12-inch centers. All joints and voids shall be filled with Owens-Corning #110 cement, well troweled into openings. For 705 FRK insulation, all joints and voids shall be FRK taped and vapor sealed. There shall be applied over the insulation surface 1-inch galvanized wire netting laced together at all edges and wired to the steel bands with 16 gauge soft annealed wire. Over this shall be applied 2-inch thick layer of Owens-Corning #110 cement applied in two layers. Install metal corner beads at all corners and edges in order to provide a permanent installation. Onto the dry cement surface apply a brush coat of Foster Sealfas 30-36 or Childers CP-50AMV1 lagging adhesive at the rate of 60-70 square feet per gallon. Embed into wet coating a layer of 8 ounce canvas or fiberglass lattice mesh smoothed out to avoid wrinkles and lap all seams a minimum of 2-inches. Apply a second brush coat of Sealfas 30-36 or Childers CP-50AMV1 lagging adhesive to the entire surface at the rate of 60-70 square feet per gallon. Cleanouts, nameplates, and manholes shall not be insulated, and the insulation on surrounding surfaces shall be neatly beveled off at such openings.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch (150-mm) centers, starting at corners. Install 3/8-inch- (10-mm-) diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.

2. Fabricate boxes from aluminum at least 0.040 inch (1.0 mm) thick.

3. 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.

D. Support rings shall be provided to support the top head insulation where required.

E. Insulation type materials shall be suitable for temperatures encountered by each item of equipment.

2.5. ACCESSORY MATERIALS

A. Accessory materials installed as part of insulation work under this section shall include, but not be limited to:

1. Closure Materials - Butt strips, bands, wires, staples, mastics, adhesives; pressure-sensitive tapes.

2. Field-applied jacketing materials - sheet metal, plastic, canvas, fiber glass cloth, insulating cement; PVC fitting covers, PVC jacketing.

3. Support Materials - Hanger straps, hanger rods, saddles.

4. Fasteners, weld pins/studs, speed clips, insulation washers.

5. Metal mesh or expanded metal lagging.

B. All accessory materials shall be installed in accordance with project drawings and specifications, manufacturer's instructions, and/or in conformance with the current edition of the Midwest Insulation Contractors Association (MICA) "Commercial & Industrial Insulation Standards."

2.6. FIELD-APPLIED JACKET

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, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto PVC Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.

3. Color: High gloss 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 P-trap and supply covers for lavatories.

2.7. HANGER BLOCKS

A. For all pipes larger than 3 inches in diameter the hanger blocks shall be high compressive strength foam or wood blocks. Wood blocks shall be precision cut thickness to match specified insulation and shall include flared edge hanger saddle as manufactured by Buckaroo.

B. The wood blocks shall be suitable for temperatures from -120 degrees Fahrenheit to 200 degrees Fahrenheit. Do not utilize the wood blocks for piping systems operating outside of the indicated temperature range.

C. Wood blocks are not acceptable for use at refrigerant pipe hangers.

PART 3. EXECUTION

3.1. WORKMANSHIP

A. The Contractor shall take special care to prevent soiling equipment below or adjacent to areas being insulated. He shall be completely responsible for removing insulation cement splashes and smears and all surfaces that he mars or otherwise soils or defaces, and he will be totally responsible for restoring these damaged surfaces to their like-new condition when delivered to the site.

3.2. SITE INSPECTION

A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.

B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturers' recommendations.

C. Verify, by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments, that all materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and

physical properties.

3.3. PREPARATION

A. Ensure that all pipe and equipment surfaces over which insulation is to be installed are clean and dry.

B. Ensure that insulation is clean, dry, and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.

C. Ensure that pressure testing of piping or duct systems has been completed prior to installing insulation.

3.4. INSTALLATION

A. Piping Systems

1. General:

a. Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
b. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.
c. Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tear or other damage. Seal all tears, punctures and other penetrations of the pipe insulation vapor barrier coating.
d. On exposed piping, locate insulation and cover seams in least visible location.

2. Fittings: Cover valves, fittings, unions, flanges, strainers, flexible connections, expansion joints, pump bodies, strainers, blowdowns, backflow preventers, autoflow valves and similar items in each piping system using one of the following:

a. Mitered sections of insulation equivalent in thickness and composition to that installed on straight pipe runs.
b. Cold pipe fittings: Apply a tack coat of vapor barrier coating and reinforcing mesh to produce a smooth surface. After ½ hour, apply a second coat of same vapor barrier coating, UL labeled, Type C, for cold water piping.
c. Hot pipe fittings and Type H for hot water piping: Apply tack of breather mastic. Wrap fitting with fiberglass reinforcing cloth overlapping adjoining sections of pipe insulation by 2-inches. Apply a second coat of Type C or Type H breather mastic over the reinforcing cloth, working it to a smooth finish.
d. Insulation cement equal in thickness to the adjoining insulation.

e. PVC fitting covers insulated with material equal in thickness and composition to adjoining insulation.

3. Penetrations: Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise specified.

4. Joints:

a. Butt pipe insulation against hanger inserts. For hot pipes, apply 3-inch (7.5cm) wide vapor barrier tape or bank over butt joints. For cold piping, apply wet coat of vapor barrier lap cement on butt joints, and seal joints with 3-inch (7.5cm) wide vapor barrier tape or band.
b. All pipe insulation ends shall be tapered and sealed, regardless of service.

B. Equipment Insulation:

1. General:

a. Install insulation in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
b. Install insulation on equipment after installation of heat tracing, painting, testing, and acceptance tests.
c. Install insulation materials with smooth, even surfaces. Rework poorly fitted joints. Do not use joint sealer or mastic as filler for joint gaps and excessive voids resulting from poor workmanship. Apply insulation using staggered joint method for both single and double layer installation, applying each layer of insulation separately.
d. Coat insulated surfaces where specified on contract drawings with layer of insulating cement, troweled in a workmanlike manner, leaving a smooth and continuous surface. Fill in seams, broken edges, and depressions. Cover over wire mesh and joints with cement sufficiently thick to remove surface irregularities.
e. Maintain the integrity of factory-applied vapor barrier jacketing on all insulation, protecting it against puncture, tears or other damage. Seal all tears, punctures and other penetrations of equipment insulation facing.
f. Where specification calls for field-applied all-service vapor barrier jacketing, it shall be neatly fitted and tightly secured. Lap seams 2-inches (5cm) (min.). Seal all joints with adhesive. Tape with 3-inches (7.5cm) matching pressure-sensitive tape or 3-inch (7.5cm) glass fabric and vapor barrier coating.
g. On exposed equipment, locate insulation and cover seams in least visible location.

2. Removable Insulation: Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance, such as vessel covers, fasteners, flanges, frames accessories, manholes, handholes, cleanouts ASME stamp, and manufacturer nameplates.

3. Areas Left Uninsulated: Items such as handholes, clean-outs, ASME stamp, and manufacturers' nameplates should be left uninsulated unless omitting insulation

would cause a condensation problem. When such is the case, provide removable insulation and appropriate tagging to identify the presence of these items. Provide neatly beveled edges at interruptions of insulation.

4. Equipment Exposed to Weather: Protect outdoor insulation from weather by installation of weather barrier mastic protective finish or jacketing as recommended by the jacketing manufacturer.

3.5. FIELD QUALITY ASSURANCE

A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

3.6. PROTECTION

A. Replace damaged insulation which cannot be satisfactorily repaired, including insulation with vapor barrier damage and moisture-saturated insulation.

B. The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

3.7. SAFETY PRECAUTIONS

A. Insulation contractor's employees shall be properly protected during installation of all insulation. Protection shall include proper attire when handling and applying insulation materials, and shall include (but not be limited to) disposable dust respirators, gloves, hard hats, and eye protection.

B. The insulation contractor shall conduct all job site operations in compliance with applicable provisions of the Occupational Safety and Health Act, as well as with all state and/or local safety and health codes and regulations that may apply to the work.

3.8. INSULATION COVERING

A. Unless otherwise noted, all exposed equipment insulation shall have a field applied PVC jacket cover neatly cut and pasted over insulation. PVC shall be high gloss white and shall be 20 mils thick.

B. Unless otherwise noted, all exposed pipe insulation required to be insulated shall be jacketed with a PVC Jacketing with fitting covers. PVC jacket shall be color fade resistant, white high gloss, U.S.D.A. authorized as manufactured by Proto Corporation or approved equal. PVC jacketing shall be high impact, ultraviolet resistant PVC. Minimum thickness shall be 20 mils, roll stock ready for shop or field cutting and forming.

C. Exposed areas include, but are not limited to, all mechanical equipment rooms/fan rooms, boiler rooms and exposed in an occupied space.

D. Where PVC jackets are indicated, install with 1 inch overlap at longitudinal seams and end

joints, for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturers 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.

END OF SECTION

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SECTION 23 08 00
COMMISSIONING OF HVAC

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. This Section includes requirements for commissioning the HVAC system and its subsystems and equipment. This Section supplements the general requirements specified in Division 01 Section 01 91 13 "General Commissioning Requirements."

B. Related Sections include the following:

1. Division 01 Section 01 91 13 "General Commissioning Requirements" for general requirements for commissioning processes that apply to this Section.

C. The following systems and/or equipment shall be commissioned:

1. Automatic Temperature Control System
2. Chilled Water System
3. Cooling Tower
4. Exhaust Fan
5. Flow Measuring Stations
6. Flow Switches
7. HVAC Controls and Sequences of Operation
8. Pumps
9. Refrigerant Monitoring System
10. Variable Frequency Drives
11. Dampers

1.3. DEFINITIONS

A. Engineer: Includes Engineer identified in the Contract for Construction between Owner and Contractor, plus consultant/design professionals responsible for design of HVAC, electrical, controls for HVAC systems, and other related systems.

B. CxA: Commissioning Authority.

C. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

D. TAB: Testing, Adjusting, and Balancing.

1.4. CONTRACTOR'S RESPONSIBILITIES

A. The following responsibilities are in addition to those specified in Division 01 Section 01 91 13 "General Commissioning Requirements."

B. Contractor:

1. Attend procedures meeting for TAB Work.

2. Certify that TAB Work is complete.

3. Assist performing functional performance tests.

C. Mechanical Contractor:

1. Attend TAB verification testing.

2. Provide measuring instruments and logging devices to record test data, and data acquisition equipment to record data for the complete range of testing for the required test period.

3. Assist performing functional performance tests.

D. HVAC Instrumentation and Control Contractor: With the CxA, review control designs for compliance with the Contract Documents, controllability with respect to actual equipment to be installed, and recommend adjustments to control designs and sequence of operation descriptions. Assist with performing functional performance tests.

E. TAB Subcontractor:

1. Contract Documents Review: With the CxA, review the Contract Documents before developing TAB procedures.

a. Verify the following:
i. Accessibility of equipment and components required for TAB Work.
ii. Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.
iii. Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.
iv. Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both TAB and commissioning testing.

v. Air and water flow rates have been specified and compared to central equipment output capacities.

b. Identify discontinuities and omissions in the Contract Documents.

c. This review of the Contract Documents by the TAB Subcontractor satisfies requirements for a design review report as specified in Division 23 Section 23 05 93 "Testing Adjusting & Balancing for HVAC."

d. Assist performing functional performance tests.

2. Additional Responsibilities: Participate in tests specified in Division 23 Section 23 09 00 "Instrumentation & Control for HVAC."

F. Electrical Contractor:

1. With the Mechanical Contractor, coordinate installations and connections between and among electrical and HVAC systems, subsystems, and equipment.

2. Attend TAB verification testing.

1.5. COMMISSIONING DOCUMENTATION

A. The following are in addition to documentation specified in Division 01 Section 01 91 13 "General Commissioning Requirements."

B. Test Checklists: CxA with assistance of Contractor shall develop test checklists for HVAC systems, subsystems, and equipment, including interfaces and interlocks with other systems. CxA shall prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. In addition to the requirements specified in Division 01 Section 01 91 13 "General Commissioning Requirements," checklists shall include, but not be limited to, the following:

1. Calibration of sensors and sensor function.

2. Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of test.

3. Control sequences for HVAC systems.

4. Strength of control signal for each set point at specified conditions.

5. Responses to control signals at specified conditions.

6. Sequence of response(s) to control signals at specified conditions.

7. Electrical demand or power input at specified conditions.

8. Power quality and related measurements.

9. Expected performance of systems, subsystems, and equipment at each step of test.

10. Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether the observed performance at each step meets the expected results.

11. Interaction of auxiliary equipment.

12. Issues log.

1.6. SUBMITTALS

A. The following submittals are in addition to those specified in Division 01 Section 01 91 13 "General Commissioning Requirements."

B. Testing Procedures: CxA shall submit detailed testing plan, procedures, and checklists for each series of tests. Submittals shall include samples of data reporting sheets that will be part of the reports.

C. Certificate of Readiness: CxA shall compile certificates of readiness from Contractor certifying that systems, subsystems, equipment, and associated controls are ready for testing.

D. Certificate of Completion of Installation, Prestart, and Startup: CxA shall certify that installation, prestart, and startup activities have been completed. Certification shall include completed checklists provided by TAB Subcontractor as specified in Division 23 Section 23 05 93 "Testing Adjusting & Balancing for HVAC."

E. Test and Inspection Reports: CxA shall compile and submit test and inspection reports and certificates, and shall include them in systems manual and commissioning report.

F. Corrective Action Documents: CxA shall submit corrective action documents.

G. Certified TAB Reports: CxA shall submit verified, certified TAB reports.

PART 2. PRODUCTS (NOT USED)

PART 3. EXECUTION

3.1. TESTING PREPARATION

A. Prerequisites for Testing:

1. Certify that HVAC systems, subsystems, and equipment have been completed, calibrated, and started; are operating according to the Contract Documents; and that Certificates of Readiness are signed and submitted.

2. Certify that HVAC instrumentation and control systems have been completed and calibrated; are operating according to the Contract Documents; and that pretest set points have been recorded.

3. Certify that TAB procedures have been completed, and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

4. Test systems and intersystem performance after approval of test checklists for systems, subsystems, and equipment.

5. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

6. Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.

7. Inspect and verify the position of each device and interlock identified on checklists. Sign off each item as acceptable, or failed. Repeat this test for each operating cycle that applies to system being tested.

8. Check safety cutouts, alarms, and interlocks with and life-safety systems during each mode of operation.

9. Annotate checklist or data sheet when a deficiency is observed.

10. Verify equipment interface with monitoring and control system and TAB criteria; include the following:

    a. All temperature alarms.
    b. All pump status alarms.
    c. Total exhaust airflow and total outdoor-air intake.
    d. Pump flow rates, pressure and amperage at each operating mode.
    e. Sequences of operation of all HVAC equipment.
    f. Variable speed drive parameters at each operated mode.
    g. Operation/Accuracy of flow measuring stations at various flow rates.
    h. Chiller flow rates, temperatures, set points, and safeties.
    i. Cooling tower flow rates, temperatures, set points, and safeties.
    j. Fluid flow rates and temperature for all water cooled equipment.
    k. Test flow switches.
    l. Refrigerant monitoring system and fan/damper interlocks.

11. Verify proper responses of monitoring and control system controllers and sensors to include the following:

    a. For each controller or sensor, record the indicated monitoring and control system reading and the test instrument reading. If initial test indicates that the test reading is outside of the control range of the installed device, check calibration of the installed device and adjust as required. Retest malfunctioning devices and record results on checklist or data sheet.
    b. Report deficiencies and prepare an issues log entry.

12. Verify that HVAC equipment field quality-control testing has been completed and approved. CxA shall direct, witness, and document field quality-control tests, inspections, and startup specified in individual Division 23 Sections.

B. Testing Instrumentation: Install measuring instruments and logging devices to record test data for the required test period. Instrumentation shall monitor and record full range of operating conditions and shall allow for calculation of total capacity of system for each mode of operation. For individual room cooling tests, provide temporary heaters to impose a cooling load. Operational modes include the following:

1. Cooling Mode.
2. Occupied and unoccupied.
3. Life-safety and safety systems.
4. Fire safety.
5. Temporary upset of system operation.
6. Special cycles.
7. Lead/lag modes where redundant equipment is indicated.
8. All alarms.
9. Flow switch shut-down and alarm.
10. Refrigerant alarm and evacuation.

3.2. TAB VERIFICATION

A. TAB Subcontractor shall coordinate with CxA for work required in Division 23 Section 23 05 93 "Testing Adjusting & Balancing for HVAC." TAB Subcontractor shall copy CxA with required reports, sample forms, checklists, and certificates.

B. Contractor, HVAC Contractor, and CxA shall witness TAB Work.

C. TAB Preparation:

1. TAB Subcontractor shall provide CxA with data required for "Pre-Field TAB Engineering Reports" specified in Division 23 Section 23 05 93 "Testing Adjusting & Balancing for HVAC."

    a. CxA shall use this data to certify that prestart and startup activities have been completed for systems, subsystems, and equipment installation.

D. Verification of Final TAB Report:

1. CxA shall select, at random, 10 percent of report for field verification.
2. CxA shall notify TAB Subcontractor 10 days in advance of the date of field verification; however, notice shall not include data points to be verified. The TAB Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.

3. Failure of an item is defined as follows:

   a. For all readings a deviation of more than 10 percent.

4. Failure of more than 10 percent of selected items shall result in rejection of final TAB report.

E. If deficiencies are identified during verification testing, CxA shall notify the HVAC Contractor and Engineer, and shall take action to remedy the deficiency. Architect shall review final tabulated checklists and data sheets to determine if verification is complete and that system is operating according to the Contract Documents.

F. CxA shall certify that TAB Work has been successfully completed.

3.3. TESTING

A. Test systems and intersystem performance after test checklists for systems, subsystems, and equipment have been approved.

B. Contractors and subcontractors must pre-inspect and pre-test all equipment and systems prior to requesting functional performance testing by the CxA. All pre-start/start-up checklists and functional performance test forms must be completed and submitted to Engineer prior to scheduling formal functional performance testing.

C. Perform tests using design conditions whenever possible.

1. Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when written approval for simulated conditions is received from CxA. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

2. Alter set points when simulating conditions is not practical and when written approval is received from CxA.

3. Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical. Do not use sensor to act as signal generator to simulate conditions or override values.

D. Scope of HVAC Contractor Testing:

1. Testing scope shall include entire HVAC installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. It shall include measuring capacities and effectiveness of operational and control functions.

2. Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

E. Detailed Testing Procedures: CxA, with HVAC Contractor, TAB Subcontractor, and HVAC Instrumentation and Control Contractor, shall prepare detailed testing plans, procedures, and checklists for HVAC systems, subsystems, and equipment.

F. HVAC Instrumentation and Control System Testing:

1. Field testing plans and testing requirements are specified in Division 23 Section 23 09 00 "Instrumentation & Control for HVAC". The CxA, HVAC Contractor, Equipment Provider/Manufacturer and the HVAC Instrumentation and Control Contractor shall collaborate to prepare testing plans.

2. CxA shall convene a meeting of appropriate entities to review test report of HVAC instrumentation and control systems.

G. Refrigeration System Testing: HVAC Contractor shall prepare a testing plan to verify performance of chiller and cooling tower and other refrigeration systems. Plan shall include the following:

1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.

2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

H. HVAC Distribution System Testing: HVAC Contractor shall prepare a testing plan to verify performance of exhaust and other distribution systems. Include HVAC terminal equipment and unitary equipment. Plan shall include the following:

1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.

2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

3. Equipment, air flow rates, air temperatures, fluid flow rates, safeties, and pump operation.

I. Deferred Testing:

1. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, the deficiency shall be documented and reported to Owner. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.

2. If the testing plan indicates specific seasonal testing, appropriate initial performance tests shall be completed and documented and additional tests scheduled.

J. Testing Reports:

1. Reports shall include measured data, data sheets, and a comprehensive summary describing the operation of systems at the time of testing.

2. Include data sheets for each controller to verify proper operation of the control system, the system it serves, the service it provides, and its location. For each controller, provide space for recording its readout, the reading at the controller's sensor(s), plus comments. Provide space for testing personnel to sign off on each data sheet.

3. Prepare a preliminary test report. Deficiencies will be evaluated by Engineer to determine corrective action. Deficiencies shall be corrected and test repeated.

END OF SECTION

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INSTRUMENTATION AND CONTROL FOR HVAC
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SECTION 23 09 00
INSTRUMENTATION AND CONTROL FOR HVAC

PART 1. GENERAL

1.1. SUMMARY

A. For General Mechanical Requirements, see Division 23 Section 23 05 00 “Common Work Results for HVAC”, and Division 01 Sections.

B. Comply with all code requirements and fire safety requirements as specified in Division 23 Section 23 05 00 “Common Work Results for HVAC”.

C. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

D. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory wired controls.

E. The automatic temperature control system ATC and central control and monitoring system (CCMS) shall be electric/electronic direct digital control (DDC) Johnson Controls FX as installed by Modern Controls, All work associated with the automatic temperature control system shall be performed by personnel regularly and directly employed by the Automatic Temperature Controls Contractor. Control System shall be web based, allowing the client access via a standard web browser.

F. Coordinate controls with controlled equipment. Upon completion of the work, calibrate and adjust all controls for proper function. Electric wiring, including interlock wiring for equipment such as fans, pumps, chillers, refrigerant monitoring system, and cooling towers, etc., shall be furnished and installed under this section. All electrical work shall conform to the applicable requirements of Division 26.

G. All automatic temperature control dampers, valves and separable wells for immersion elements furnished by the Control Manufacturer shall be installed by the Mechanical Contractor or his sheet metal subcontractor under the Control Manufacturer's supervision.

H. Reference is hereby made for this contractor to become familiar with Division 26 of these specifications. Familiarization is for coordination purposes only. The control contractor shall provide all necessary relays, contacts, interlock wiring etc. not provided under Division 26 for the automation of the ATC and CCMS systems as required by the sequence of operation and input/output schedule. The control contractor shall provide all additional devices and interlock wiring required for the automation of the ATC system and monitoring of the CCMS system.

I. Furnish all labor, materials, software, equipment and services necessary for and incidental to furnishing and installing a complete direct digital control, automatic temperature control system to meet the requirements of the sequence of operation described on the Drawings.

J. Unless the necessary items are specified to be provided with mechanical equipment by Division 23, the ATC contractor shall coordinate with Division 23, Mechanical, and shall

furnish and install all items necessary to meet the requirements of the Sequence of Operation and the Central Control and Monitoring System (CCMS) indicated on the drawings and as required in this specification.

K. The control system shall include all necessary and specified control equipment properly installed in accordance with the specifications and drawings and shall include, but not be limited to the automatic temperature control and energy management system of the following:

1. Condenser Water System/Cooling Tower
2. Chilled Water Systems
3. Dual Temperature System
4. Flow Measuring Stations
5. Flow Switches
6. General Exhaust System
7. Mechanical Room Ventilation Control
8. Refrigerant Monitoring System
9. Condenser Water Pump

L. All labor, material, equipment and software to meet the functional intent of the system, as specified herein and as shown on the drawings, shall be included. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans, that are required to meet the functional intent, shall be provided without additional cost to the owner.

M. Where equipment is specified to be provided by equipment manufacturer or where packaged controls are specified map out all points provided by the manufacturer so the same can be viewed by ATC system. As a minimum all points indicated in the point list and control diagram must be viewable and adjustable from the ATC system. Coordinate with equipment manufacturer.

1.2. DEFINITIONS

A. DDC: Direct digital control.

B. I/O: Input/output.

C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.

D. MS/TP: Master slave/token passing.

E. PC: Personal computer.

F. PID: Proportional plus integral plus derivative.

G. RTD: Resistance temperature detector.

H. UPS: Uninterruptible Power Supply.

I. NAE: Network Automated Engine.

1.3. SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.

2. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.

3. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.

4. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.

5. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.

6. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.

7. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:

a. Water Temperature: Plus or minus 1 deg F (0.5 deg C).
b. Water Flow: Plus or minus 5 percent of full scale.
c. Water Pressure: Plus or minus 2 percent of full scale.
d. Space Temperature: Plus or minus 1 deg F (0.5 deg C).
e. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).
f. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).
g. Air Pressure (Ducts): Plus or minus 0.1-inch wg (25 Pa).

1.4. DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

1.5. COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with

plans and room details before installation.

B. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

C. Coordinate equipment with Division 26 Section 26 24 16 “Panelboards” to achieve compatibility with starter coils and annunciation devices.

1. Coordinate equipment with Division 26 Section 26 29 13 “Enclosed Controllers” to achieve compatibility with motor starters and annunciation devices.

1.6. WORK BY OTHERS

A. Automatic temperature control valves, air flow stations, pipe taps, flow meters, and separable wells for immersion elements furnished by the control manufacturer shall be installed by the mechanical contractor under the control manufacturer's supervision. The control contractor shall deliver to the mechanical contractor valves and wells for installation within the various systems.

B. All automatic dampers furnished by the control manufacturer shall be installed by the mechanical contractor under the control manufacturer's supervision.

1.7. QUALITY ASSURANCE

A. The automatic temperature control (ATC) system and the central control and monitoring system (CCMS) shall be as manufactured by Johnson Controls FX as installed by Modern Controls.

B. Supplier shall have an in-place support facility with technical staff, spare parts inventory and all necessary test and diagnostic equipment. The fully staffed and equipped office shall be within a 60 mile radius of the job site.

C. The systems shall be complete in all respects, and shall be installed by skilled personnel. The Control Contractor shall have a successful history in the installation and maintenance of automatic temperature control systems similar in size and performance to that specified herein.

D. All electrical wiring in connection with the Automatic Temperature Control System shall be furnished and installed by the ATC Contractor. This shall include all interlock wiring between the fans, pumps, chillers, refrigerant monitoring system, cooling towers, and dampers.

E. Bids by wholesalers, contractors or franchised dealers or any other firm whose principal business is not that of manufacturing or installing automatic temperature control systems, shall not be acceptable. Bid documents that are not complete in their response to these documents or take exception to any of the capabilities defined within these documents shall not be acceptable.

F. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.

G. 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.

H. Comply with ASHRAE 135 for DDC system components.

1.8. GUARANTEE AND INSTRUCTION

A. The control system including all components, system software, parts and assemblies herein specified shall be free from defects in workmanship and materials under normal use and service. After completion of the installation, the Control Manufacturer shall regulate and adjust all thermostats, control valves, control motors, and other equipment provided under this contract. If within two (2) years from the date of acceptance by Owner any of the equipment herein described is proved to be defective in workmanship or materials, it will be replaced or repaired at no additional cost to the Owner. The Control Manufacturer shall, after completion, provide any service incidental to the proper performance of the Control System under guarantees outlined above for a period of two (2) years. Normal maintenance of the system is not to be considered part of the guarantee. All corrective modifications made during warranty service periods shall be updated on all user documentation including "as-built" shop drawings and on user and manufacturer archived software disks.

B. The control contractor shall completely check out, calibrate and test all connected hardware to insure that the system performs in accordance with the approved specifications and sequences of operation submitted.

C. Upon completion of the work, the control drawings encased in heavy plastic shall be provided where directed. Layout shall show all control equipment and the function of each item indicated.

D. The temperature control contractor's office shall be within a 60 mile radius of the job site.

E. The contractor shall respond to the job site with qualified technicians within a 4 hour period for any emergency relating to the control system or energy management systems.

F. This agreement shall include emergency service during normal working hours.

1.9. SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.

2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.

3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

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. Bill of materials of equipment indicating quantity, manufacturer, and model number.

2. Schematic flow diagrams showing equipment, fans, pumps, coils, dampers, valves, and control devices.

3. Wiring Diagrams: Power, signal, and control wiring.

4. Details of control panel faces, including controls, instruments, and labeling.

5. Written description of sequence of operation.

6. Schedule of dampers including size, leakage, and flow characteristics.

7. Schedule of valves including flow characteristics.

8. DDC System Hardware:

a. Wiring diagrams for control units with termination numbers.
b. Schematic diagrams and floor plans for field sensors and control hardware.
c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.

10. Controlled Systems:

a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
c. Written description of sequence of operation including schematic diagram.
d. Points list.

C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with LonWorks or Bacnet.

D. Software and Firmware Operational Documentation: Include the following:

1. Software operating and upgrade manuals.

2. Program Software Backup: On a magnetic media or compact disc, complete with data files.

3. Device address list.

4. Printout of software application and graphic screens.

5. Software license required by and installed for DDC workstations and control systems.

E. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

F. Qualification Data: For Installer and manufacturer.

G. Field quality-control test reports.

H. Submit screen shots of ATC system graphics at substantial completion.

I. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section 01 78 23 Operation and Maintenance Data, and Division 23 Section 23 05 00 “Common Work Results for HVAC” include the following:

1. Maintenance instructions and lists of spare parts for each type of control device.

2. Interconnection wiring diagrams with identified and numbered system components and devices.

3. Keyboard illustrations and step-by-step procedures indexed for each operator function.

4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

5. Calibration records and list of set points.

J. Upon completion of the work, provide a complete set of “as-built" drawings and application software on CD, USB, or other type of electronic storage device. Drawings shall be provided in format as acceptable to the Owner’s files. Submit as-built drawings and specification to Owner's representative for review and approval prior to final project closeout.

1.10. SOFTWARE LICENSE AGREEMENT

A. The owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.

B. Software license agreement shall not apply on projects where existing ATC system is being extended.

1.11. ELECTRICAL SURGE PROTECTION

A. It is the responsibility of the ATC/FMS contractor to provide adequate surge protection for all wall mounted control panels required for this project.

1. Devices under surge protection shall be of design that loss of memory will not occur in the event of the surge protection device being activated due to surge/spike conditions.

2. Surge protection devices will be required to be hard wired, with the exception of peripheral devices that use standard 110VAC plugs for connections (i.e. Modems).

3. Surge protection devices are to be rated for 120 VAC single phase, 20 (or greater) amps capacity.

4. Surge Protection devices to include internal fuse protection, audible surge alarm & LED indicators.

5. Surge protectors to have clamping voltage of 480V peak, maximum surge current rating of 50,000 amps. Unit to have NEMA 12 enclosure with wall mounting bracket and conduit connection.

1.12. TRAINING

A. Upon completion of the work, the Control Contractor shall have completely adjusted the entire control system. He shall arrange to instruct the Owner's representative on the operation of the control system for a period of not less than one (1) eight (8) hour day. All training shall be by the control contractor and shall utilize specified manuals and as-built documentation.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.

2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs. Include a minimum of 40 hours' dedicated instructor time on-site.

3. Review data in maintenance manuals. Refer to Division 01 Section 01 77 00 “Close-Out Procedures”.

4. Review data in maintenance manuals. Refer to Division 01 Section 01 78 23 “Operation and Maintenance Data”.

5. Schedule training with Owner with at least seven days' advance notice.

1.13. ALTERNATES

A. Refer to Division 01 Section 01 23 00 “Alternates” for description of work under this

section affected by alternates.

1.14. NEW CASTLE COUNTY VOCATIONAL TECHNICAL SCHOOL DISTRICT SPECIFIC REQUIREMENTS

A. The ATC Subcontractor shall include in his bid all costs associated with incorporating the following specific requirements:

1. All holiday schedules shall incorporate a 12 month block. Coordinate exact holidays, schedules, calendars, occupied, unoccupied periods with Owner prior to writing software. All schedules shall be reviewed and approved by the Owner.

2. All exhaust fans shall be assigned a designated point. Utilizing relays to provide digital point for exhaust fans shall not be acceptable.

3. Graphics on ATC computer shall in addition to basic requirements indicate the percentage open or closed on all valves and dampers.

4. The ATC Computer Graphics shall incorporate the final room numbers actually utilized in the school. All room names utilized in the graphic display shall be reviewed and approved by the Owner.

5. The ATC Computer Graphics shall indicate for each item of equipment the “on” or “off” status and command shall be “run” or “stop”.

6. All Temperature Sensors, equipment, current sensors, differential pressure sensors, etc. indicated on ATC Control Diagrams and point list shall be displayed on the ATC Computer Graphic. Measured value or status shall be displayed.

7. For any multi-stage HVAC units, the quantity of compressor stages and shall be displayed on the Computer Graphics.

8. The outside air temperature shall be monitored on ATC system and reported on ATC Computer Graphics.

9. Provide a graphic of all floor plans indicating location of all equipment interlocked with ATC System including all control panels.

10. Graphic shall also indicate area of building served by each item of equipment. Graphics shall indicate all global sensor readings.

11. All equipment shall be labeled with name of equipment, area served, and area location (room name/number).

12. Provide additional software package and license so that Owner can install software on Owner provided laptop. Assist owner with installation of software.

1.15. GLOBAL SENSORS

A. General

1. Furnish and install global sensors and report the same on the automatic temperature

control system.

2. Global sensors shall monitor and trend the following conditions:

   a. Outside air temperature.
   b. Chilled water supply water and return temperature.
   c. Condenser water supply and return water temperature.
   d. All ventilation fan speeds where variable frequency drives are specified.
   e. Outside air carbon dioxide level.
   f. All equipment interlocked with ATC system shall be able to be turned on/off via ATC system as specified. Changing temperature set point alone is not acceptable method for turning equipment on/off.
   g. Where valve or damper position is indicated ATC graphic shall indicate percentage open or percentage closed.

PART 2. PRODUCTS

2.1. BUILDING MANAGEMENT SYSTEM

A. The Building Management System (BMS) shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BMS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.

B. The Building Management System shall consist of the following:

1. Standalone Network Automation Engine(s)

2. Field Equipment Controller(s)

3. Input/Output Module(s)

4. Local Display Device(s)

5. Portable Operator's Terminal(s)

6. Distributed User Interface(s)

7. Network processing, data storage and communications equipment

8. Other components required for a complete and working BMS

C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.

D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

E. Acceptable Manufacturers

1. Johnson Controls (FX).

F. Automation Network

1. The automation network shall be based on a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard "off the shelf" products available through normal PC vendor channels.

2. The automation network shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication.

3. Network Automation Engines (NAE) and/or system controllers shall reside on the automation network.

4. The automation network will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.

G. Control Network

1. Network Automation Engines and/or system controllers shall provide supervisory control over the control network and shall support all three (3) of the following communication protocols:

   a. Tridium FX-40

2. Control networks shall provide either "Peer-to-Peer," Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.

3. DDC Controllers shall reside on the control network.

4. Control network communication protocol shall be BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135.

5. A BACnet Protocol Implementation Conformance Statement shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.

6. The Conformance Statements shall be submitted 10 day prior to bidding.

H. Integration

1. Hardwired

   a. Analog and digital signal values shall be passed from one system to another via hardwired connections.
   b. There will be one separate physical point on each system for each point to be integrated between the systems.

2. BACnet Protocol Integration – BACnet

   a. The neutral protocol used between systems will be BACnet over Ethernet and comply with the ASHRAE BACnet standard 135-2003.
   b. A complete Protocol Implementation Conformance Statement (PICS) shall be provided for all BACnet system devices.
   c. The ability to command, share point object data, change of state (COS) data and schedules between the host and BACnet systems shall be provided.

I. Dedicated Web Based User Interface

1. Where required by the Owner, the BMS Contractor shall provide and install a personal computer for command entry, information management, network alarm management, and database management functions. All real-time control functions, including scheduling, history collection and alarming, shall be resident in the BMS Network Automation Engines to facilitate greater fault tolerance and reliability. Coordinate with Owner to determine computer type (i.e. PC (Windows based) or Macintosh (Apple)).

2. Dedicated User Interface Architecture – The architecture of the computer shall be implemented to conform to industry standards, so that it can accommodate applications provided by the BMS Contractor and by other third party applications suppliers, including but not limited to Microsoft Office Applications. Specifically it must be implemented to conform to the following interface standards.

   a. Microsoft Internet Explorer for user interface functions
   b. Microsoft Office Professional for creation, modification and maintenance of reports, sequences other necessary building management functions
   c. Microsoft Outlook or other e-mail program for supplemental alarm functionality and communication of system events, and reports
   d. Required network operating system for exchange of data and network functions such as printing of reports, trends and specific system summaries.

J. User Interface Application Components

1. Operator Interface

   a. An integrated browser based client application shall be used as the user operator interface program.
   b. All Inputs, Outputs, Setpoints, and all other parameters as defined within Part 3 or on the drawings, shown on the design drawings, or required as part of the system software, shall be displayed for operator viewing and modification from the operator interface software.
   c. The user interface software shall provide help menus and instructions for each operation and/or application.
   d. All controller software operating parameters shall be displayed for the operator to view/modify from the user interface. These include: setpoints, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.

e. The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:
   i. User access for selective information retrieval and control command execution
   ii. Monitoring and reporting
   iii. Alarm, non-normal, and return to normal condition annunciation
   iv. Selective operator override and other control actions
   v. Information archiving, manipulation, formatting, display and reporting
   vi. FMS internal performance supervision and diagnostics
   vii. On-line access to user HELP menus
   viii. On-line access to current FMS as-built records and documentation
   ix. Means for the controlled re-programming, re-configuration of FMS operation and for the manipulation of FMS database information in compliance with the prevailing codes, approvals and regulations for individual FMS applications.
   x. The operation of the control system shall be independent of the user interface, which shall be used for operator communications only. Systems that rely on an operator workstation to provide supervisory control over controller execution of the sequences of operations or system communications shall not be acceptable.

2. Navigation Trees

   a. The system will have the capability to display multiple navigation trees that will aid the operator in navigating throughout all systems and points connected. At minimum provide a tree that identifies all systems on the networks.
   b. Provide the ability for the operator to add custom trees. The operator will be able to define any logical grouping of systems or points and arrange them on the tree in any order. It shall be possible to nest groups within other groups. Provide at minimum 5 levels of nesting.
   c. The navigation trees shall be “dockable” to other displays in the user interface such as graphics. This means that the trees will appear as part of the display, but can be detached and then minimized to the Windows task bar or closed altogether. A simple keystroke will reattach the navigation to the primary display of the user interface.

3. Alarms

   a. Alarms shall be routed directly from Network Automation Engines to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the user interface shall, at the minimum, provide the following functions:
      i. Log date and time of alarm occurrence.
      ii. Generate a “Pop-Up” window, with audible alarm, informing a user that an alarm has been received.
      iii. Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
      iv. Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit

trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.

v. Provide the ability to direct alarms to an e-mail address or alphanumeric pager. This must be provided in addition to the pop up window described above. Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.

vi. Any attribute of any object in the system may be designated to report an alarm.

b. The FMS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions

c. The FMS shall annunciate application alarms as required.

4. Reports and Summaries

a. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:

i. All points in the BMS
ii. All points in each BMS application
iii. All points in a specific controller
iv. All points in a user-defined group of points
v. All points currently in alarm
vi. All points locked out
vii. All BMS schedules
viii. All user defined and adjustable variables, schedules, interlocks and the like.

b. Summaries and Reports shall be accessible via standard UI functions and not dependent upon custom programming or user defined HTML pages.

c. Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report or summary on the system printer for use as a building management and diagnostics tool.

d. The system shall allow for the creation of custom reports and queries via a standard web services XML interface and commercial off-the-shelf software such as Microsoft Access, Microsoft Excel, or Crystal Reports.

5. Schedules

a. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:

i. Weekly schedules
ii. Exception Schedules
iii. Monthly calendars

b. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.

c. It shall be possible to define one or more exception schedules for each schedule including references to calendars

d. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days for a minimum of five years in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as

previously defined on the exception schedules.

e. Changes to schedules made from the User Interface shall directly modify the Network Automation Engine schedule database.

f. Schedules and Calendars shall comply with ASHRAE SP135/2003 BACnet Standard.

g. Selection of a single menu item or tool bar button shall print any displayed schedule on the system printer for use as a building management and diagnostics tool.

6. Password

a. Multiple-level password access protection shall be provided to allow the user/manager to user interface control, display, and database manipulation capabilities deemed appropriate for each user, based on an assigned password.

b. Each user shall have the following: a user name (24 characters minimum), a password (12 characters minimum), and access levels.

c. The system shall allow each user to change his or her password at will.

d. When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.

e. A minimum of five levels of access shall be supported individually or in any combination as follows:
   i. Level 1 = View Data
   ii. Level 2 = Command
   iii. Level 3 = Operator Overrides
   iv. Level 4 = Database Modification
   v. Level 5 = Database Configuration
   vi. Level 6 = All privileges, including Password Add/Modify

f. A minimum of 100 unique passwords shall be supported.

g. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.

h. The system shall automatically generate a report of log-on/log-off and system activity for each user. Any action that results in a change in the operation or configuration of the control system shall be recorded, including: modification of point values, schedules or history collection parameters, and all changes to the alarm management system, including the acknowledgment and deletion of alarms.

7. Screen Manager - The User Interface shall be provided with screen management capabilities that allow the user to activate, close, and simultaneously manipulate a minimum of 4 active display windows plus a network or user defined navigation tree.

8. Dynamic Color Graphics

a. The graphics application program shall be supplied as an integral part of the User Interface. Browser or Workstation applications that rely only upon HTML pages shall not be acceptable.

b. The graphics applications shall include a create/edit function and a runtime function. The system architecture shall support an unlimited number of

graphics documents (graphic definition files) to be generated and executed.

c. The graphics shall be able to display and provide animation based on real-time data that is acquired, derived, or entered.

d. Graphics runtime functions – A maximum of 16 graphic applications shall be able to execute at any one time on a user interface or workstation with 4 visible to the user. Each graphic application shall be capable of the following functions:
   i. All graphics shall be fully scalable
   ii. The graphics shall support a maintained aspect ratio.
   iii. Multiple fonts shall be supported.
   iv. Unique background shall be assignable on a per graphic basis.
   v. The color of all animations and values on displays shall indicate the status of the object attribute.

e. Operation from graphics – It shall be possible to change values (setpoints) and states in system controlled equipment by using drop-down windows accessible via the pointing device

f. Graphic editing tool – A graphic editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing/defining all animations, and defining all runtime binding.
   i. The graphic editing tool shall in general provide for the creation and positioning of point objects by dragging from tool bars or drop-downs and positioning where required.
   ii. In addition, the graphic editing tool shall be able to add additional content to any graphic by importing backgrounds in the SVG, BMP or JPG file formats.

g. Aliasing – Many graphic displays representing part of a building and various building components are exact duplicates, with the exception that the various variables are bound to different field values. Consequently, it shall be possible to bind the value of a graphic display to aliases, as opposed to the physical field tags.

9. Historical trending and data collection

   a. Each Automation Engine shall store trend and point history data for all analog and digital inputs and outputs, as follows:
      i. Any point, physical or calculated, may be designated for trending. Two (2) methods of collection shall be allowed:
         1. Defined time interval
         2. Upon a change of value.
      ii. Each Automation Engine shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.

   b. Trend and change of value data shall be stored within the engine and uploaded to a dedicated trend database or exported in a selectable data format via a provided data export utility. Uploads to a dedicated database shall occur based upon one of the following: user-defined interval, manual command, or when the trend buffers are full. Exports shall be as requested

by the user or on a time scheduled basis.

10. Trend data viewing and analysis

    a. Provide a trend viewing utility that shall have access to all database points.
    b. It shall be possible to retrieve any historical database point for use in displays and reports by specifying the point name and associated trend name.
    c. The trend viewing utility shall have the capability to define trend study displays to include multiple trends
    d. Displays shall be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style.
    e. Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.
    f. Display magnitude shall automatically be scaled to show full graphic resolution of the data being displayed.
    g. Trend studies shall be capable of calculating and displaying calculated variables including highest value, lowest value and time based accumulation.

K. Network Automation Engine (NAE)/ System Controllers

1. The Network Automation Engine (NAE)/ System Controllers or approved equal shall be a fully user-programmable, supervisory controller. The NAE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.

2. Automation network – The NAE shall reside on the automation network and shall support a subnet of system controllers.

3. User Interface – Each NAE shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.

    a. The web based UI software shall be imbedded in the NAE. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
    b. The NAE shall support up four (4) concurrent users.
    c. The web based user shall have the capability to access all system data through one NAE.
    d. Remote users connected to the network through an Internet Service Provider (ISP) or telephone dial up shall also have total system access through one NAE.
    e. Systems that require the user to address more than one NAE to access all system information are not acceptable.
    f. The NAE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the NAE.
    g. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.

h. The web based UI shall support the following functions using a standard version of Microsoft Internet Explorer:
   i. Configuration
   ii. Commissioning
   iii. Data Archiving
   iv. Monitoring
   v. Commanding
   vi. System Diagnostics

i. Systems that require workstation software or modified web browsers are not acceptable.

j. The NAE shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.

4. Processor – The NAE shall be microprocessor-based with a minimum word size of 32 bits. The NAE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NAE size and capability shall be sufficient to fully meet the requirements of this Specification.

5. Memory – Each NAE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.

6. Hardware Real Time Clock – The NAE shall include an integrated, hardware-based, real-time clock.

7. The NAE shall include troubleshooting LED indicators to identify the following conditions:

   a. Power - On/Off
   b. Ethernet Traffic – Ethernet Traffic/No Ethernet Traffic
   c. Ethernet Connection Speed – 10 Mbps/100 Mbps
   d. FC Bus – Normal Communications/No Field Communications
   e. Peer Communication – Data Traffic Between NAE Devices
   f. Run – NAE Running/NAE In Startup/NAE Shutting Down/Software Not Running
   g. Bat Fault – Battery Defective, Data Protection Battery Not Installed
   h. Fault – General Fault
   i. Modem RX – NAE Modem Receiving Data
   j. Modem TX – NAE Modem Transmitting Data

8. Communications Ports – The NAE shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator's terminals.

   a. Up to two (2) USB port
   b. Up to two (2) URS-232 serial data communication port
   c. Up to two (2) RS-485 port
   d. One (1) Ethernet port

9. Diagnostics – The NAE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network

Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.

10. Power Failure – In the event of the loss of normal power, The NAE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.

    a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
    b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

11. Certification – The NAE shall be listed by Underwriters Laboratories (UL).

12. Controller network – The NAE shall support the following communication protocols on the controller network:

    a. The NAE shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
        i. A BACnet Protocol Implementation Conformance Statement shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.
        ii. The Conformance Statements shall be submitted 10 day prior to bidding.
        iii. The NAE shall support a minimum of 100 control devices.
    b. The NAE shall support the Johnson Controls N2, Tridium FX-40, or Honeywell Webs or approved equal Field Bus.
        i. The NAE shall support a minimum of 100 N2 control devices.
        ii. The Bus shall conform to Electronic Industry Alliance (EIA) Standard RS-485.
        iii. The Bus shall employ a master/slave protocol where the NAE is the master.
        iv. The Bus shall employ a four (4) level priority system for pollng frequency.
        v. The Bus shall be optically isolated from the NAE.
        vi. The Bus shall support the Metasys Integrator System.

2.2. WIRING

A. The multi-conductor cable for field wiring of electronic analog sensors shall be minimum No. 22 AWG, 300 volt, thermoplastic with stranded copper wire and 100 percent shield coverage. The number of conductors in each sensor cable shall be as determined by the Contractor. 2/c #22 shielded cables shall be Belden Cat. #8451 3/c #20 shielded cables shall be Belden Cat. #9770 or approved equal.

B. Conductors for digital sensors or contact control shall be the same as for the analog sensors, except the grounded shield is not required.

C. Individual conductors shall be color coded and in addition shall be numbered in the field to identify the particular terminal to which attached. Field numbering shall be performed with Brady or approved equal markers wrapped around the wire near the terminal connection. All wires shall be terminated with pressure type connectors suitable for wire size, material and terminal connection.

D. All exposed wiring or wiring concealed in partitions shall be installed in a designated conduit raceway. The conduit shall conform to Division 26 of the specification. Where wiring is installed in an air plenum the same shall be plenum rated cable.

E. All junction boxes shall have covers painted safety green, and be rigid steel.

2.3. CHILLER THERMAL DISPERSION FLOW SWITCHES

A. Furnish and install thermal dispersion flow switches in chiller piping systems (chilled water and condenser water) as indicated on the Contract Drawings. The chiller thermal dispersion flow switches shall be manufactured by IFM Efector, Inc., or approved equal. Coordinate exact chiller thermal dispersion flow switch requirements with the chiller manufacturer.

B. Units shall be normally open type and shall be interlocked to prevent chiller from operating until the fluid flow is proven. Unit shall be fully adjustable and include function display LED. Units shall be constructed of 316L stainless steel including housing and material surface sensor. All wetted surfaces shall also be constructed of 316L stainless steel.

C. Furnish with M12 connector and wiring for interface to chiller and automatic temperature control system. Coordinate wiring with ATC system and chiller control panel.

D. Include assembly, sensor, and adaptors as required.

2.4. CONTROLLERS

A. All sensors shall be NIST certified and shall be fully traceable. Provide documentation certifying the same.

2.5. DAMPERS

A. Control Dampers

1. The temperature control contractor shall provide all automatic control dampers of the types indicated on the plans and not specified to be integral with other equipment. Frames shall be not less than 16 gauge galvanized steel. Blades shall not be over 6 inches wide airfoil shaped double skin construction of 14 gauge equivalent thickness. Bearings shall be stainless steel sleeves with 2 inch shafts. Blade edge seals shall be vinyl blade with flexible metal compressible jamb seals of the tight-seal spring type. Dampers and seals shall be suitable for temperature ranges of -40 to 250 degrees F.

2. All proportional control dampers shall be opposed blade type and all two-position dampers shall be parallel blade type.

3. Dampers shall be sized to meet flow requirements of the application. The sheet

metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 6 inches.

4. Dampers shall be minimum leakage type to conserve energy and the temperature control manufacturer shall submit leakage and flow characteristic data for all control dampers with the temperature control submittal. Maximum leakage shall be 3 CFM/Sq. Ft. at static pressure of 1 inch W.C. for a damper width of 48 inches.

5. Low pressure rectangular control dampers shall be Type CD60 airfoil low leakage damper as manufactured by Ruskin or as approved equal of American Warming and Ventilating, Air Balance and Arrow.

6. Provide damper end switch for all control dampers where indicated. Damper end switch shall be independent of the damper actuator and shall provide “proof of open” prior to allowing fan to energize. Damper end switch shall be Model TS-475 Mechanical Damper Arm Switch (no-mercury) as manufactured by MDI, Inc. or approved equal. Install per manufacturer’s recommendations on control damper. End switch shall have the following features:

   a. Housing Material: Glass filled PBT (polybutylene terephthalate).
   b. Bracket Material: Plated steel.
   c. Operation: Steel ball actuated sub-miniature snap action switch.
   d. Operating angle: 15 degrees. (Contact closes at 10 degrees above horizontal and contact opens at 5 degrees below horizontal).

B. Damper Operators

1. Electric damper actuators shall be properly sized to provide sufficient torque to position the damper throughout its operating range.

2. Use devices which are quiet in operation and which in the event of power failure, will "fail safe" by spring action in either the normally open or normally closed position as required for freeze, moisture, smoke, or fire protection.

3. Electric actuators requiring a 24 VAC power supply will be utilized. Motors shall be specifically designed and sized with proper torque according to requirements of the device it is to be used on (i.e.: valve, damper). Each actuator will accept the proper control input as the system is designed, (i.e,: floating, 0-10VDC, 4-20Ma etc.) without the need for any additional interface devices.

4. For all exterior damper operators provide NEMA 4X stainless steel corrosion resistant enclosure. Damper operator enclosure shall be model ZS-300 as manufactured by Belimo or approved equal.

2.6. CONTROL PANELS

A. Furnish and install local panels for ATC devices. Control panels shall be fully enclosed cabinets, all steel construction and shall meet the requirements of NEMA 1 enclosures. Cabinet shall have piano hinged door with a locking latch. All cabinet locks shall use common key. Provide means of storing control system instructions and drawings inside cabinet for future reference. Panel shall be wall mounted or free standing and located

where directed by the Contract Drawings or Engineer.

1. Each panel shall have all internal devices factory wired to a numbered terminal strip. Controllers and associated devices shall be mounted within the panel, accessible through a hinged door.

2. All ATC panels shall be provided with integral disconnect, wiring, and control transformers.

3. Any ATC control panel that is serving equipment on the emergency generator must be powered by an emergency generator fed circuit/electrical panel. Refer to electrical contract documents for all emergency powered equipment.

2.7. MISCELLANEOUS ELECTRICAL DEVICES

A. Electric Actuators. All automatically controlled devices, unless specified otherwise elsewhere, shall be provided with electric actuators which shall be sized to operate their appropriate loads with sufficient reserve power to provide smooth modulating action or two-position action and tight close off as specified.

B. Aquastats shall be line voltage strap on type with single pole, single throw switching. Switches shall have an adequate rating for the applied load. All wiring from aquastats to domestic recirculating pumps shall be by ATC contractor.

2.8. UNINTERRUPTIBLE POWER SUPPLY

A. Furnish, size and install uninterruptible power supplies (UPS’s) at all ATC panels.

B. Provide all interlock and power wiring from U.P.S. to control panels as required such that all components are powered via the UPS. For hard-wired equipment furnished with pigtails/wire leads, e.g. control power transformers, splice pigtails/wire leads in junction box to a flexible cord with NEMA 5-15P Plug, which shall be plugged into the UPS.

C. UPS's shall be sized for the ATC panel load and shall provide at least ten (10) minutes of full load power in the event of a power outage.

2.9. CENTRAL CONTROL AND MONITORING SYSTEM (CCMS) (HARDWARE DESCRIPTION)

A. General

1. The Facilities Management Control System (FMCS) shall be comprised of a network of various independent, Stand-alone Digital Controllers (SDC'S), Mechanical System Digital Controllers (MSDC's), Air Handler Digital Controllers (AHDC's), Unitary Digital Controllers (UDC's),; together with Centralized Control Stations (CCS), and Centralized Host Stations (CHS) as specified, to provide centralized access and facility wide control functions. The SDC's, MSDC's, AHDC's, and UDC's shall be interconnected in a communicating network to provide facility wide access and sharing of information. A Gateway Digital Controller (GDC's) shall be provided to allow interface with third party microprocessor based control systems that are specified for integration within

specification. A Local Area Network (LAN) shall be provided to interconnect SDC's for high-speed data transmission.

2. Specification Nomenclature

a.	FMCS	Facility Management Control System
b.	SDC	Stand-alone Digital Controller
c.	MSDC	Mechanical System Digital Controller
d.	AHDC	Air Handler Digital Controller
e.	UDC	Unitary Digital Controller
f.	GDC	Gateway Digital Controller
g.	GP	Graphical Programmer
h.	CHS	Central Host Station
i.	CCS	Central Control Station
j.	RPTR	Communications Repeater

B. Centralized Host Stations (CHS)

1. The FMCS shall include Centralized Host Stations. CHS's shall, in conjunction with the full compliment of Digital Controllers, provide the performance requirements within this specification. Each CHS shall include all hardware and software components to serve as a centralized facility operator station, providing color graphics, facility wide access, operator initiation of global control strategies, and centralized documentation.

The CHS shall be capable of simultaneously interfacing with the following:

a. -mouse pointing device
b. -two parallel printers
c. -high resolution VGA color graphics monitor
d. -seven auto answer/auto dial modems
e. -color inkjet printer
f. -two serial printers
g. -three FMCS LAN interface
h. -Alarm Graphic and Report FAX dial out service interface
i. -Mass storage tape system

As a minimum, the temperature control contractor shall provide the types and quantities of CHS, CCS, SDC, MSDC, AHDC, GDC, and UDC as required.

2. Computer

a. The existing FMS computer located in the Maintenance Office shall be utilized with the new CCMS System if compatible with the same. If the selected ATC contractor cannot tie into the existing computer, then a new stand-alone computer shall be furnished.
b. Coordinate IP address with Owners' I.T. Department for network connection. The CCMS must be fully networkable.
c. Provide fiber optic cable as required.

3. Operator Workstation: One PC-based microcomputer with minimum

configuration as follows:

a. Uninterruptible Power Supply: 2 kVa.
b. Operating System: Microsoft Windows – Latest Version.
   i. ASHRAE 135 Compliance: Workstation shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
   ii. LonWorks Compliance: Control units shall use LonTalk protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.
c. Printer: Color, ink-jet type as follows:
   i. Print Head: 4800 x 1200 dpi optimized color resolution.
   ii. Paper Handling: Minimum of 100 sheets.
   iii. Print Speed: Minimum of 17 ppm in black and 12 ppm in color.

C. Centralized Control Stations (CCS)

1. The FMCS shall include Centralized Control Stations, as required. CCS's shall, in conjunction with the network of SDC's and additional CCS components as required, provide the performance requirements within this section of the specification. Each CCS shall include all hardware and software components to serve as a centralized facility operator station, providing facility wide access, for review and modification of global control strategies, real time system monitoring, controller database editing or creation, and centralized documentation.

D. Local Area Networks

1. The LAN shall utilize packetized transmissions, CRC 16 error checking, and distributed error recovery. Single or multiple SDC failures shall not cause loss of communication between other LAN-connected SDC's.

2. LAN connected SDC's shall be provided with a communications watchdog to assure that an individual SDC cannot permanently occupy the LAN. If an SDC is determined to be monopolizing communications, it shall be automatically shut down and an exception reported to annunciate this fact.

3. The LAN shall employ a token passing, peer-to-peer convention, same as or similar to the industry standard format IEEE 802.4. The content of messages shall be the manufacturer's standard. The Local Area Network components shall be manufacturer's standard or available from third party vendors which utilize the same chip implementation as used by the manufacturer.

4. Industry standard ANSI, RS-485 Network Communication System, Lon, or Bacnet, or Equivalent shall be utilized.

5. Trunk Wiring Practices - General

   a. The distributed communication network system shall consist of a multi-drop RS-485 bus architecture connecting SDC's, MSDC's, AHDC's, GDC's, and UDC's. The trunk shall consist of:
      i. A twisted pair of wires (24 awg) completely encased in continuous

metallic conduit.

ii. A twisted shielded pair of wires (24awg) with the shield grounded in accordance with the manufacturer's wiring practices.

iii. Or a dual channel, 62.5 micron fiber cabling system with ST type connectors.

There shall be no power wiring, in excess of 30 VAC rms voltage, run in conduit with communications trunk wiring. In cases where power or signal wiring is run in conduit with trunk wiring, all communications trunk wiring and power wiring shall be run using separate twisted shielded pairs (24awg) with the shields grounded in accordance with the manufacturer's wiring practices.

b. Communication Transient Protection

i. The manufacturer's catalog data sheet shall provide evidence that all FMCS products offered by the manufacturer are tested and comply with the standard for Transient Surge withstand capabilities for electrical devices ANSI C62.41, IEEE-587-1980, Categories A and B. Such testing shall have included power and communication trunk wiring. Compliance with IEEE-587 shall imply conformance with IEEE-472 transient standards based on the stated position of ANSI and IEEE regarding applicability of the rated standards.

ii. In addition, at each building entry and exit point, the wire communications trunk wiring shall be protected with a transient surge protection device providing the minimal protection specifications of the General semiconductor, Model #422E device. Transient surge protection is not necessary if the communication trunk, external to the building, is fiber optic in nature.

iii. The communications circuitry and input/output circuitry, of the SDC's, MSDC's, and AHDC's, shall provide protection against a 1000 volt, 3 amp transient signal, directly applied to the communication or input/output terminations. The manufacturer's catalog data sheet shall provide evidence of conformance with this requirement. Systems not complying with this requirement shall provide equivalent protection external to the FMCS controller. Protection shall be provided for the individual communications and input/output terminations for each FMCS controller. Submittal documentation shall clearly define how this requirement will be met and how the external protection will not affect the performance of the controllers.

c. RS-485 Trunk Distance and Topology

The manufacturer's RS-485 trunk shall provide operation over end to end linear distances of 4000 feet for wire connections and 6,500 feet for fiber optic connections, without repeaters, at communication data rates of up to 64 kbps. The trunk may be extended up to 20,000 feet through the use of wire repeaters or 80,000 feet through the use of fiber optic repeaters.

At data rates of up to 19.2 kbps, the trunk distance shall be extendible to distances of up to 20,000 feet using RS-485 communication wire or fiber optic repeaters. A repeater shall be used each 4,000 feet of linear distance for wire or every 6,500 feet for fiber optics. Repeating devices shall contain separate LED indication for each communication interface trunk

to indicate proper operation of the repeater as well as the communications trunks.

Contractors shall provide devices which are of FMCS control system manufacturer's design.

d. It shall be possible for the trunk to be "T" eed or "starred", at any location using a repeater, to facilitate the installation. Systems which do not provide this capability shall provide a trunk riser diagram showing end to end distances and locations of system topology necessary to meet the trunk diagram shown on the plans.

e. Fiber Optic Communication Trunk

The temperature control contractor shall provide a dual channel fiber optic data link, as required, to minimize the effects of transient surges caused by lightning or external EMI generating equipment. The data link shall be comprised of a single duplex cable containing two fibers (transmit and receive), of 62.5 micron construction, to accommodate data rates of up to 64 kbps.

The fiber optic trunk shall be connected to SDC devices using manufacturer's standard RS-485 to fiber optic data link modem. Repeating devices shall contain separate LED indication for each communication interface and the fiber modem, to indicate proper operation of all aspects of the device. Fiber modem devices shall be tested and conform with transient surge withstand tests for electrical devices, ANSI C62.41 IEEE-587 Categories A and B. Manufacturer's data sheet shall provide evidence of compliance with this requirement. Manufacturer's products which do not meet this minimum performance requirement shall not be acceptable.

Systems which require a special gateway controller to accommodate the fiber optic trunks, shall provide such a controller per point where the fiber optic cable enters and leaves the building. Gateway controllers shall not inhibit transfer of point data values between SDC controllers throughout the LAN. Such inhibitive systems shall not be acceptable.

In lieu of the above two options, the contractor may provide a fiber optic link to each SDC controller within the LAN. All controllers shall have access to the fiber optic link for LAN.

Fiber optic cable shall be fully tested and terminated by the temperature control contractor.

E. Standalone Digital Controllers (SDC)

1. General

Standalone Digital Controllers (SDC) shall be 16 bit microcomputer based, utilizing a multi-tasking, multi-user operating system.

The SDC controllers shall permit the simultaneous operation of all control, communication facilities management and operator interface software, as programmed by the Contractor or User. Modification of the on-board SDC controller database shall be performed on-line using the built-in or HHOT interface. Systems which require the SDC to be removed from service while DDC control sequences are modified shall not be acceptable.

SDC controllers shall utilize true floating point arithmetic capabilities. To

accommodate totalization of large totalized values, SDC's with reporting capability shall support the calculation, accumulation and display of values within the range of +/-10 to the 10th power.

2. Database and Memory Back-up

All programming defining the functions to be performed by the SDC, including but not limited to application programs and point database within each SDC, shall be protected from loss due to power failure for a minimum of six months. Systems providing non-volatile memory for these functions are preferred. Systems not providing non-volatile memory shall provide a system rechargeable battery backup system sufficient to provide protection for the specified 6 month period. Systems not in compliance shall provide for uninterrupted power to each SDC.

3. Service Ports

SDC controllers shall be equipped with a minimum of one operator service port for the connection of a HHOT. The service port shall be either a built-in RS-232 data terminal port or an RJ-11 type jack which connects to the manufacturer's standard HHOT.

Connection of a service device, to a service port, shall not cause the SDC controller to lose communications with its peers or other networked device controllers.

The service port shall allow utilization of the same HHOT from any location. The same HHOT shall be utilized for any SDC, MSDC, AHDC, and UDC, Systems which utilize more than one variety of HHOT shall not be acceptable.

4. Display and Readout Capability

The SDC controller shall provide manufacturer’s standard display and readout capability.

5. Manual/Auto Control and Notification

The SDC controller shall provide commanded override capability from the HHOT or the built-in operator interface. Such overrides shall be annunciated to the CHS's. Such overrides shall be valid as long as power is applied to the controller.

Manual service overrides, such as Hand/Off/Auto switches, shall be provided as indicated on the drawings. Such overrides shall be located at the controlled device location and conform with OSHA Manual lockout regulations, as appropriate, for safety reasons. SDC indication of such manual override actions shall be provided as feedback status indication points shown on the drawings, in conjunction with the application programs within the SDC. Systems which provide built-in H/O/A switching devices with integral feedback shall provide external manual service overrides, as indicated, to comply with OSHA manual lockout regulations. H/O/A switches remotely located at the SDC controller are not acceptable.

6. Adjustments

Every control panel shall provide adjustments for the functions specified. In general, adjustments shall be provided for all set points used by controllers within each control panel. In addition, adjustments shall be provided for throttling ranges, mixed air damper minimum positions, or other items as specified. Adjustments shall be integral to each individual SDC. The built-in operator interfaces shall allow the easy execution of the adjustment through named identifiers within the SDC. From a single SDC user interface, any other SDC shall be accessible and full adjustment capabilities shall be provided.

7. Sensing and Control Outputs Requirements

a. Sensing

i. All sensing inputs shall be provided via industry standard signals. Temperatures, humidities, differential pressure signals, and other signal inputs shall be one of the following types:

1) 0-20 mA
1) 4-20 mA
1) 0-5 VDC
1) 0-12 VDC

ii. 1000 ohm platinum (at O{SYMBOL 176\f"Symbol"}C,2.62 ohms/C)

iii. 1000 ohm Balco (2.2 ohms/{SYMBOL 176\f"Symbol"}F)

iv. 10 k ohm Thermistor (at 25{SYMBOL 176\f"Symbol"}C/77{SYMBOL 176\f "SYMBOL"}F)

Custom, definable input signals (accept sensor inputs from RTD devices, other than those of the manufacturer).

All signal inputs shall be compatible with the controllers used, and with the requirements for readout of variables in true scaled engineering units as specified.

b. Control Outputs

i. On/Off Outputs

Control panel shall internally provide test points for the circuit driving the equipment contactor, for the purpose of troubleshooting the 120 VAC or 240 VAC circuit to the contactor. All such relays or digital output modules shall provide a pilot light or LED display of the same status. On/Off output modules shall be of the modular construction that can be easily and quickly replaced, on an individual basis, if the module were to be damaged.

ii. Modulating Outputs

Modulating outputs shall be industry standard 0-5 VDC, or 0-12 VDC with definable output spans, to adapt to industry available control products. Milliamp outputs of 0-20 mA or 4-20 mA are also acceptable. Drive open/Drive closed type modulating outputs are acceptable provided that they also comply with the following requirements.

All modulating outputs shall provide within the control panel, a meter gauge, or display indication via on board display or HHOT, the commanded position signal for the actuating device. This meter, gauge, or display must provide either a 0-100 percent position indication, or read out directly in the engineering unit of the signal being used. Drive open/Drive closed type controllers shall include sufficient components and control algorithms to comply with this requirement. In the case of Drive open/closed technology, position feedback shall be provided to insure

positive indication that the control device is at the commanded position.

F. Mechanical System Digital Controllers (Msdc's)

1. General

a. Controls shall be microprocessor based, Mechanical System Direct Digital Controllers (MSDC's). MSDC's shall be provided for air handling units, central pump systems and other applications as required. MSDC's shall be based on a minimum 16 bit microprocessor working from software program memory which is physically located in the MSDC. The application control program shall be resident within the same enclosure as the input/output circuitry which translates sensor signals. All input/output signal conversion shall be performed through a minimum of a 12 Bit A to D converter. All input/output points shall be universal in nature allowing their individual function definition to be assigned through the application software. All unused input/output points must be available as universally definable at the owner discretion. If input/output points are not fully universal in nature, unused points must be equal in quantity between Analog Input, Digital Input, Analog Output, Digital Output.
Contractor shall provide a minimum of one MSDC controller per mechanical system, as shown on the drawings.
The BAS contractor shall provide and field install al MSDC's specified under this section. Mechanical Equipment manufacturers desiring to provide MSDC type controls as factory mounted equipment, shall provide a separate bid for their product less all controls, BAS/Temperature Control Contractor.

b. All input/output signals shall be directly hardwired to the MSDC. Trouble shooting of input/output signals shall be easily executed with a volt-ohm-milli-amp meter (VOMA). As a result of this intent, it is specified that power line carrier systems, or other systems which command multiple outputs over a single pair of wires, shall not be used.

c. MSDC shall be in continuous direct communication with the network which forms the facility-wide Building Automation System (BAS). The MSDC's shall communicate with the SDC at a baud rate of not less than 19,200 baud.

2. Non-Volatile Memory

a. All control sequences programmed into the MSDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained. Power failures shall not cause the MSDC memory to be lost, nor shall there be any need for batteries to be recharged or replaced to maintain the integrity of the controller database. The MSDC shall allow for the creation of unique application control strategies. Systems that allow selection of sequences from the library or table are not acceptable.

b. All control sequences shall be fully field programmable at the MSDC controller, allowing for the creation or editing of an application sequence of operations.

c. Each MSDC shall be provided with manufacturer’s standard built-in Operator Interface.

d. The MSDC shall allow for internal processing and reporting of user defined Time of Day Schedules, Alarms, Trend Reports, Run Time Totalization, Energy Utilization Reports, Application Program Documentation and interface with a peripheral device such as an autodial/autoanswer modem, a VT-100 Display Terminal, or a serial printer.
   i. Systems not providing the above functionality at the MSDC are not acceptable and shall utilize an SDC in place of the MSDC.

e. The MSDC shall provide LED indication of transmit/receive communications performance as well as for the proper/improper operation of the controller itself.

f. The MSDC shall be provided with a battery backed time clock that is capable of maintaining the time of day and calendar for up to thirty days without loss of setting. The battery for the time clock shall be field replaceable by the customer. Integral daily, weekly, holiday and special event scheduling shall be provided, such that all schedules can be custom tailored to the facility. Predefined schedules, with set quantities of on/off cycles are not acceptable.

3. Controller Location

a. To simplify controls, mechanical service and troubleshooting, the MSDC shall be mounted directly in or on the control compartment of the mechanical system. The MSDC shall be provided in a NEMA 1 enclosure to accommodate direct mounting on the equipment to be controlled. The MSDC shall be constructed in a modular orientation such that service of the failed components can be performed quickly and easily. The modular construction should limit the quantities of printed circuit boards to a maximum of three. When required to replace a printed circuit board, it shall not be necessary to disconnect any field wiring. The MSDC shall allow for the creation of, unique, application control strategies. Systems that allow selection of sequences from a library or table are not acceptable. This shall allow all controls maintenance and troubleshooting to be made while at the unit location. MSDC shall be directly wired to sensory devices, staging relays or modulating valves for heating and cooling.

b. For compatibility to the environment of the mechanical systems, MSDC shall have wide ambient ratings. MSDC shall be rated for service from -40 Deg F (Degrees Fahrenheit) to 140 Deg F.

c. Contractor shall submit description of location for the MSDC's on all mechanical equipment.

G. Unitary Digital Controller (UDC)

1. General

a. Controls shall be microprocessor based Unitary Digital Controllers (UDC's). UDC's shall be provided for equipment as necessary. UDC's shall be based on a minimum 16 bit microprocessor working from software program memory which is physically located in the UDC. The application control program shall be resident within the same enclosure as the input/output circuitry which translates the sensor signals. All input/output

signal conversion shall be performed through a minimum of a 10 bit A to D converter.

Contractor shall provide a minimum of one UDC controller per unitary system as required.

The BAS contractor shall provide and install all UDC's specified under this section. Mechanical equipment manufacturers desiring to provide UDC type controls as factory mounted equipment, shall provide a separate bid for their products less all controls, actuators, valve assemblies and sensors, which are specified to be provided by the BAS/Temperature control contractor.

b. All input/output signals shall be directly hardwired to the UDC. Troubleshooting of input/output signals shall be easily executed with a volt-ohm-milli-amp meter (VOMA). As a result of this intent, it is specified that power line carrier systems, or other systems which command multiple outputs over a single pair of wires, shall not be utilized.

c. UDC's shall be in continuous, direct communication with the network which forms the facility wide building automation system. The UDC's shall communicate with the SDC at a baud rate of not less than 9,600 baud.

2. Non-Volatile Memory

a. All control sequences programmed into the UDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained. Power failures shall not cause the UDC memory to be lost, nor shall there be any need for batteries to be recharge or replaced to maintain the integrity of the controller database. The UDC shall allow for the creation of unique application control sequences. Systems that allow only selection of sequences from a library or table are not acceptable.

b. All control sequences shall be fully configurable at the AHDC, allowing for the creation and change of a sequence while at the unit.

c. The UDC shall be provided with the ability to interface with the HHOT. The interface port shall be provided at the wall sensor or within the unitary equipment, as specified on the plans. The interface port shall allow the HHOT to have full functionality as described hereinbefore of this specification. From the interface port, the HHOT shall be able to directly access any AHDC, and UDC, in the network.

d. The UDC shall provide an input/output point trending utility that is capable of accumulating 48 analog point samples and 10 digital point samples per Input/Output point. Each sample shall be taken on a user defined interval, ranging from 1 second to 255 hours per sample. The digital readings shall be on a change of state occurrence for the digital points. All samples shall be recorded with the engineering units for the value, along with a time and date identifier for each sample taken.

Systems unable to provide the above capability shall provide for the individual input/output point trending at the SDC. Specifics as to how each UDC point will be trended, at the SDC, shall be provided in the submittal documents. Included in the explanation shall be the sample intervals, the memory allocation in the SDC and the number of UDC's per SDC that can be expected.

e. The UDC shall provide LED indication of transmit/receive communication performance, as well as for the proper/improper operation

of the controller itself.

3. Controller Location

a. To simplify controls and mechanical service troubleshooting, the UDC shall be mounted directly in the controls compartment of the unitary system. The UDC shall be provided with a sheet metal or polymeric enclosure that is constructed of material allowing for the direct mounting within the primary air stream, as defined by UL-465. The direct mounting shall allow all controls maintenance and troubleshooting to be made while at the unitary equipment. The UDC shall be directly wired to sensory devices, staging relays or modulating valves for heating and cooling.

b. For compatibility to the environment of the unitary equipment, UDC's shall have wide ambient ratings. UDC's shall be rated for service from 32 Deg F (Degrees Fahrenheit) to 140 Deg F.

c. Contractor shall submit description of location of UDC's on all mechanical and unitary equipment.

H. Gateway Digital Controller (GDC)

1. General

a. Controls shall be microprocessor based, Gateway Digital Controllers (GDC's). GDC's shall be provided for the purpose of integrating microprocessor based, communicating, direct digital control systems from vendors other than the primary, selected controls manufacturer. GDC's shall be based on a minimum 16 bit microprocessor working from software program memory which is physically located in the GDC. All communications interface control programs shall be resident within the GDC.

The BAS contractor shall provide and field install all GDC's specified under this section. Any interface requirement beyond a two wire communications wire link, shall be provided by the equipment manufacturer supplying the non-primary or third party microprocessor based, communicating, direct digital controllers.

b. All GDC's shall exist at the LAN level with the SDC's. The GDC's shall possess all capabilities described under the SDC section while additionally providing the interface to the third party systems described above. The GDC's shall communicate with the third party controllers at the highest possible baud rate offered by the third party system. As a minimum, 9,600 baud communications shall be utilized.

c. All control sequences programmed into the GDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained. Power failures shall not cause the GDC memory to be lost, nor shall there be any need for batteries to be recharged or replaced to maintain the integrity of the controller database. The GDC shall allow the standard database information from the third party system to be integrated in standard FMCS data formats, allowing for the creation of unique application control sequences. Systems that only allow selection of data and sequences from a library or table, are not acceptable.

d. Each GDC shall be provided with manufacturer’s standard built-in

operator interface.

The GDC shall provide Alarming, point trending and Energy report generation capabilities. Alarming points shall be uniquely definable, with multiple alarms assignable to a single point. Such alarm shall be provided with a unique 80 character message. Systems utilizing an alarm message library, shall describe the size of the library and verify how all alarming within the GDC will be guaranteed unique 80 character messages.

The quantities of trended point values shall be limited only by total controller memory space. If necessary, a GDC may be dedicated fully to a trending task, allowing all controller memory to be available for the trend storage. Each unique trend report shall contain a minimum of 4 different points and a minimum of 128 samples per point. Trending frequency for each report shall be operator definable from a sample once a second to a sample once every 24 hours. Trend reports shall be internally formatted by the GDC and shall be reportable directly to a serial printer, a VT-100 display terminal, a CCS, CHS or any other device capable of receiving a formatted ASCII data file.

e. The energy reports shall not be limited in quantities only by available memory within the GDC. Each Energy Report shall be fully formatted and reportable to a serial printer, a VT-100 display terminal, a CCS, a CHS or any other device capable of receiving a formatted ASCII data file. As a minimum, each Energy Report shall provide a daily report and a monthly report with summary information such as outside air temperature, outside air humidity, total energy consumed and degree day calculations.

f. The GDC shall be provided with a battery backed clock that is capable of maintaining the time of day and calendar for up to thirty days, upon loss of power to the GDC, without loss of setting. The battery for the time clock shall be field replaceable by the customer.

2.10. SYSTEM SOFTWARE DESCRIPTION

A. General

1. Contractor shall provide all software for a complete and operational system as described herein. Software shall include manufacturer's standard multi-tasking, multi-user operating system for operator consoles and controllers, network communication software for dial-up and hard trunk applications, operator man-machine interface software, control application software and all other software necessary to provide the functions specified herein.

2. System software shall be as manufactured by Johnson Controls.

2.11. EXCEPTION REPORTING SEQUENCES

A. Alarm/COS Reports

1. For those digital points indicated on the drawings, the Contractor shall provide a unique change-of-state alarm message of up to 70 characters. The message shall report to all devices assigned to the alarm class.

2. For those points indicated on the drawings which are designated as interrupt

priority, the Contractor shall provide an interrupting process display at the CHS location which displays the current conditions for the operator.

In addition, the CHS computer shall automatically send a picture of the process graphic display to the remote locations specified on the drawings as receiving facsimile copies of interrupting alarms.

3. For those points designated in paragraph 3 above, the FMCS shall also send a history log to the system report printer of the immediate prior history of the points causing the interrupt priority. This log shall contain 1 minute samples of the previous 15 minutes of operation.

4. For those points on the drawings designed as Hard Facts points, the Contractor shall provide an alarm message to a remote facsimile location designated by the Owner. The FMCS system shall provide at the remote location, a facsimile print-out showing location, time/date of alarm and alarm message of the point. For interrupt priority fax alarms, the remote facsimile machine shall receive a hard copy of the interrupt process screen showing on-line dynamic data values of the current conditions.

B. Off Hours Exception Reporting

1. The Owner shall specify up to five sites to which off hours exceptions shall be auto-dialed and reported. This shall allow the owner to assign off hours exception responses to various facility personnel as necessary. Selection of the site to be dialed can be programmed by the Owner, and set to change automatically per time of day and day of week.

2.12. MONITORING SYSTEM, SENSORS AND WIRING

A. Sensors and other Devices for Input/Output Summary Schedule:

1. Provide all necessary sensors, relays, panels, conduits and wire for the points indicated in the input/output summary as shown on the contract drawings.

2. Analog sensing elements for remote indication shall be independent of local sensors used for local control loops.

3. Temperature sensors shall be Resistance Temperature Detector (RTD) type of 1000 ohm balco. Space (60-90 degrees F); Duct/Well (-30-250 degrees F); Averaging Duct (-30-225 degrees F) or as required under Division 26.

   a. Space temperature sensors shall be provided with blank commercial type locking satin chrome covers.
   b. Duct temperature sensors shall be rigid stem or averaging type as specified in the sequence of operation. Water sensors shall be provided with a separable copper, monel or stainless steel well. Outside air wall mounted sensors shall be provided with a sun shield.
   c. The dew point sensor shall employ a non-reactive organic bobbin material to give precise dew point readings with accuracy of not more than + 1.5 degrees F. The dew point sensor shall incorporate an integral draft shield

as part of the instrument for air velocities in excess of 50 feet per minute. The dew point sensor shall operate over a minimum dew point temperature range suitable to application.

4. Differential and Static Pressure Sensors and Switches

Fan proof-of-flow switches shall be U.L. listed adjustable set point and differential pressure type. Switches shall be piped to fan discharge except where fans operate at less than one inch WG, they shall be piped across the fan. For fractional horsepower and non-ducted fans, relays or auxiliary contacts may be used. Maximum pressure rating shall be at least 10 inches WG. with .05-12 inch W.C. range.

a. Pump proof-of-flow switches shall be U.L. listed adjustable differential pressure or flow type as specified in the sequence of operation or data point summary. Devices shall be 150 psi rated except chilled water flow switches shall be provided with totally sealed vapor tight switch enclosure on 300 psi body. Differential pressure switches shall have valved manifold for servicing, and a range of 3 psi-150 psi.

b. Air flow and static pressure analog sensors shall be high accuracy suitable for the low velocity pressures to be encountered, be selected for approximately 50 percent overrange, and have a 4 to 20 ma output. These differential pressure sensors shall be connected to the air flow measuring station with valved lines for testing and calibration, and shall have adjustments for zero and span. 5 inch W.C. range.

c. Water flow analog sensors shall be provided complete with flow element and shall be an all solid state precision industrial type with stainless steel meter body, maximum error of no more than .5 percent or span, and 4 to 20 ma output. Sensor shall be rated for 250 psi minimum and installed in strict accordance to the manufacturer's instructions complete with three-valve manifold for calibration and maintenance.

5. Overall system accuracy, including electronic analog sensing elements, shall be as follows:

a. Air: Plus or minus 1.0 degrees F temperature, plus or minus 2.5 percent r.h., plus or minus 2.0 percent static pressure.

b. Water: Plus or minus 0.7 degrees F over full scale range for water points, plus or minus 1.0 degree F for others.

c. BTU Calculations: Plus or minus .3 degrees F for water input points.

d. Proof of fan or pumps operating status, or alarm conditions shall be through positive feedback from differential pressure switches across fan or pump. Auxiliary dry contacts may be used for proof of fans or pumps if the motors are fractional H.P., and other non-ducted fans.

6. Digital inputs from devices with isolated, dry type contacts (no grounds, no voltage) of either normally open (N.O.) or normally closed (N.C.) configuration shall be provided. Live contact inputs, those that have voltage present, shall be provided with isolating devices to meet dry contact requirements.

7. Start-stop relay module shall contain relays for start-stop function at the remote point, with relays mounted and factory wired to numbered terminal strips.

8. Outage Devices:

   a. Control Relays: Control relay contacts shall be rated for the application, with a minimum of two sets of Form C contacts, enclosed in a dustproof enclosure. Relays shall have silver-cadmium contacts with a minimum life-span rating of one million operations. Operating time shall be 20 milliseconds or less, with release time of 10 milliseconds or less. Relays shall be equipped with coil transient suppression limiting transients to nondamaging levels.
   b. Time Delay Relays: Time delay relay contacts shall be rated for the application with a minimum of two sets of Form C contacts enclosed in a dustproof enclosure. Relays shall have silver-cadmium contacts with a minimum life span rating of one million operations. Relays shall be equipped with coil transient suppression devices to limit transients to nondamaging levels. Delays contact opening or closing shall be adjustable from one to 60 seconds with a minimum accuracy of plus or minus 2 percent of setting.
   c. Latching Relays: Latching relay contacts shall be rated for the application with a minimum of two sets of Form C contacts enclosed in a dustproof enclosure. Relays shall have silver-cadmium contacts with a minimum life-span rating of one million operations. Operating time shall be 20 milliseconds or less, with release time of 10 milliseconds or less. Relays shall be equipped with coil transient suppression devices to limit transients to nondamaging levels.
   d. Reed Relays: Reed relays shall be encapsulated in a glass-type container housed in a plastic or epoxy case. Contacts shall be rated for the application. Operating and release times shall be one millisecond or less. Reed relays shall have a minimum life span rating of 10 million operations.
   e. Contactors: Contactors shall be of the single-coil, electrically operated, mechanically held type. Positive locking shall be obtained without the use of hooks, latches, or semi-permanent magnets. Contacts shall be double-break silver-to-silver type protected by arcing contacts. Number of contacts and ratings shall be selected for the application. Operating and release times shall be 100 milliseconds or less. Contactors shall be equipped with coil transient suppression devices to limit transients to nondamaging levels.
   f. Solid-State Relays: Input-output isolation shall be greater than 1000 megohms with a breakdown voltage of 1500 V rms or greater at 60 Hz. The contact life shall be 10 million operations or greater. The ambient temperature range shall be minus 20 degrees to plus 140 degrees F. Input impedance shall not be less than 500 ohms. Relays shall be rated for the application. Operating and release times shall be one millisecond or less. Transient suppression shall be provided as an integral part of the relay to limit transients to nondamaging levels.

9. Audible Alarm:

   a. All alarms shall annunciate on the ATC system front end computer and via pagers.

2.13. FLOW MEASURING STATIONS

A. Furnish and install an Onicon Model F-1210, Hersey, Kobold or approved equal dual turbine insertion flow sensor complete with hot tap full port ball valve and installation hardware. The dual turbine element shall have counter rotating axial turbine elements, each with its own rotational sensing system, and an averaging circuit to reduce measurement errors due to swirl and flow profile distortion. Paddle type rotors will not be acceptable. Rotational sensing of each turbine shall be accomplished electronically by sensing impedance change and not with magnetic or photo-electric means. Each sensor shall be individually calibrated and tagged accordingly against the manufacturers primary standards which must be accurate to within 0.1 percent and traceable to the U.S. National Institute of Standards and Technology (NIST).

B. The sensor shall have a maximum operating pressure of 400 PSI, maximum operating temperature of 220 degrees F (optional 300 degrees F) and a pressure drop of less than 1 PSI at 17 feet per second flow rate. Flow sensor shall have 100:1 turndown ratio. Accuracy shall be + 2 percent of actual reading from 0.4 feet per second to 20.0 feet per second.

C. The sensor shall have integral analog outputs of 0-10 VDC and 4-20 mA current output for connection to the Central Control System. The sensor shall also include three integral frequency outputs, (top turbine, bottom turbine, average frequency) for diagnostic purposes and for connection to peripheral equipment (local display, BTU meter, etc.). All outputs shall be linear with flow rate.

D. The turbine elements shall be made of polypropylene with sapphire jewel bearings and tungsten carbide shafts. The flow sensor shall be constructed of 316 stainless steel with an aluminum electronics enclosure and gasketed cover.

E. Install flow measuring stations with minimum straight lengths of pipe upstream and downstream from sensor as prescribed by manufacturer's written instructions.

F. Make electrical connections to power supply and interlock with ATC system.

G. Calibrate meters for manufacturer’s requirements.

PART 3. EXECUTION

3.1. GENERAL

A. The Automatic Temperature Control System and Central Control and Management System, shall be designed, installed, and commissioned in a turnkey fully implemented and operational manner.

3.2. BMS SPECIFIC REQUIREMENTS

A. Graphic Displays

1. Provide a color graphic system flow diagram display for each new and existing system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.

2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection.

B. Custom Reports:

1. Provide custom reports as required for this project:

3.3. WORKSTATION INSTALLATION

A. Desktop Workstations Installation:

1. Install workstation(s) at location(s) directed by Owner.

2. Install multiple-receptacle power strip with cord for use in connecting multiple workstation components to a single duplex electrical power receptacle.

3. Install software on workstation(s) and verify software functions properly.

4. Develop Project-specific graphics, trends, reports, logs and historical database.

5. Power each workstation through a dedicated UPS unit. Locate UPS adjacent to workstation.

B. Color Graphics Application:

1. Use system schematics indicated as starting point to create graphics.

2. Develop Project-specific library of symbols for representing system equipment and products.

3. Incorporate digital images of Project-completed installation into graphics where beneficial to enhance effect.

4. Submit sketch of graphic layout with description of all text for each graphic for Owner's review before creating graphic using graphics software.

5. Seek Owner input in graphics development once using graphics software.

6. Final editing shall be done on-site with Owner's review and feedback.

7. Refine graphics as necessary for Owner acceptance.

8. On receiving Owner acceptance, print a hard copy for inclusion in operation and maintenance manual. Prepare a scanned copy PDF file of each graphic and include with softcopy of DDC system operation and maintenance manual.

3.4. INSTALLATION & SUPERVISION

A. All wiring and tubing shall be properly supported and run in a neat and workmanlike manner. All wiring and tubing exposed and in equipment rooms shall run parallel to or at right angles to the building structure. All piping and wiring within enclosures shall be neatly bundled and anchored to prevent restriction to devices and terminals.

B. The control contractor shall be responsible for all electrical installation required for a fully functional control and automation system and not shown on the electrical plans or required

by the electrical specifications. All wiring shall be in accordance to all local and national codes.

1. All line voltage wiring, all wiring exposed, and all wiring in equipment rooms shall be installed in conduit in accordance to the electrical specifications.

2. All electric and electronic wiring shall be minimum #20 AWG minimum THHN and shielded if required.

3. All wiring in the central control room shall be concealed in an approved manner.

C. Verify locations of temperature sensors and other exposed control sensors with plans and Owner prior to installation.

D. The installation and supervision of this project shall be carried out by factory trained personnel who are employed by the Contractor and licensed for this type of work.

E. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.

F. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation.

G. Install in accordance with manufacturer's instructions.

H. Check and verify location of space temperature sensors and other exposed control sensors with plans and room details before installation. Align with lighting switches.

I. Mount freeze protection thermostats using flanges and element holders.

J. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.

K. Provide separable sockets for liquids and flanges for air bulb elements.

L. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

M. Install equipment plumb and level.

N. Install all equipment to be accessible for service and maintenance.

3.5. ACCEPTANCE TESTING

A. Point Verification

To verify end-to-end operation of the system the Contractor shall provide a hard copy of an All Points Summary Listing to the Owner of each part or system to be placed in warranty by the Owner. For CHS systems, the Contractor shall additionally provide a print screen of the process display showing real time dynamic point information for all points on the

subsystem(s) to be accepted.

B. Sequence Verification

1. The Contractor shall notify the Owner's representative of systems which perform all specified sequences.

2. The warranty acceptance test shall be of 5 days duration and the system shall perform as follows:

a. During the five days, the FMCS system shall not report any system diagnostics from the subsystem under test.
b. The subsystem shall be performance verified as operational using temporary trends of each control loop located in the SDC or MSDC.
c. During the occupied periods, BAS control loops, under test, shall maintain control of the process variable within the following scales:
   i. Duct Static Pressure +/-0.3 inch WC
   ii. Pump Head Pressure +/-10 percent of control range
   iii. Duct Temperature Loops +/-2 degrees F
   iv. Room Temperature Loops +/-1degrees F
   v. Pipe Temperature Loops +/-2 degrees F
   vi. Duct Humidity +/-2x rated error of Humidity Transmitter
d. The contractor shall provide a hard copy printout of the process variable, process variable set point and control loop output percent for the period of 2 hours prior to occupancy to 2 hours after occupancy with samples taken every 15 minutes.

3.6. COORDINATE WITH TAB AGENCY

A. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air and water reset, freeze stats and duct smoke detectors.

B. Verify that all controlling instruments are calibrated and set for design operating conditions prior to commencement of TAB work.

C. Calibrate sensors after installation, and before the sensor control verification tests are performed. Prove the accuracy of final settings by taking temperature readings. The readings shall be in a typical conditional space for each separately controlled zone.

D. Allow sufficient time in the project to provide assistance and instruction to the balancing agency in the proper use and setting of control components such as, but not limited to, computers, static pressure controllers, or any other device that may need set points changed so that the testing and balancing work can be performed.

E. All control sequences, software, equipment, and components shall be started-up by a qualified technician. Start-up report shall be submitted to Engineer prior to the commencement of testing and balancing work. Testing and balancing shall not commence until start-up reports are completed, reviewed by Engineer and forwarded to Testing and Balancing Agency.

3.7. EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that systems are ready to receive work.

C. Beginning of installation means installer accepts existing conditions.

D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.

E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

F. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices, wiring, and tubing is installed prior to installation proceeding.

3.8. INTERLOCK REQUIREMENTS

A. The fan and equipment interlock requirements are as scheduled on the contract drawings.

B. Furnish and install all necessary relays, transformer, contactors, wiring, conduit, and accessories to perform fan, equipment, and damper interlocks.

C. Unless otherwise noted, fan interlocks shall be arranged such that dampers associated with fan shall be open when fan starts and close when fan stops.

3.9. SUBMITTALS AT PROJECT CLOSEOUT

A. Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

3.10. CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Install piping adjacent to machine to allow service and maintenance.

B. Ground equipment.

1. 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.

C. Connect hand-off-auto selection switches to override automatic interlock controls when switch is in hand position.

3.11. 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 unit operation. Remove and replace malfunctioning units and retest.

2. Test and adjust controls and safeties.

3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.

4. Test each point through its full operating range to verify that safety and operating control set points are as required.

5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.

6. Test each system for compliance with sequence of operation.

7. Test software and hardware interlocks.

8. Test all end switches and verify status is reported on the ATC system.

9. Test all flow switches.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.

2. Check instruments for proper location and accessibility.

3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.

4. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.

5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.

6. Check temperature instruments and material and length of sensing elements.

7. Check control valves. Verify that they are in correct direction.

8. Check DDC system as follows:

a. Verify that DDC controller power supply is from emergency power supply, if applicable.

b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
c. Verify that spare I/O capacity has been provided.
d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

E. All temperature control and interlock wiring shall be installed in conduit unless otherwise noted on the plans. Power or interlock wiring shall be run in separate conduit from sensor and communications wiring.

3.12. ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.

2. Make three-point calibration test for both linearity and accuracy for each analog instrument.

3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.

4. Control System Inputs and Outputs:

a. Check analog inputs at 0, 50, and 100 percent of span.
b. Check analog outputs using volt-ohm-milli-amp meter (VOMA) at 0, 50, and 100 percent output.
c. Check digital inputs using jumper wire.
d. Check digital outputs using ohmmeter to test for contact making or breaking.
e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:

a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 0, p50, 90, and 100 percent of span.
b. Manually operate flow switches to verify that they make or break contact.

6. Pressure:

a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:

a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of

span using a precision-resistance source.

b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers.

9. Provide diagnostic and test instruments for calibration and adjustment of system.

10. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature set points.

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 three visits to Project during other than normal occupancy hours for this purpose.

3.13. ON-SITE ASSISTANCE

A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested by Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

3.14. SCHEDULING

A. Submit spreadsheet to Owner indicating occupied/unoccupied times for each item controlled by ATC system. Incorporate all scheduling requirements into sequence of operation.

3.15. STAGING

A. Coordinate staging requirements with equipment being controlled. Where multistage units are scheduled or specified, provide all devices, controllers, wiring to control and sequence all stages.

PART 4. SEQUENCES OF OPERATION

4.1. REFER TO CONTRACT DRAWINGS FOR SEQUENCES OF OPERATION, CONTROL DIAGRAMS, AND POINTS LIST.

END OF SECTION

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HVAC AIR DISTRIBUTION
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SECTION 23 30 00
HVAC AIR DISTRIBUTION

PART 1. GENERAL

1.1. SUMMARY

A. For General Mechanical Requirements, see Division 23 Section 23 05 00 “Common Work Results for HVAC” and Division 01, “General Requirements”.

B. The fabrication and installation of all ductwork, together with related equipment, shall comply with the standards of the National Fire Protection Association, as set forth in NFPA Standard No. 90A, as well as with the requirements of the Sheet Metal and Air Conditioning Contractors' National Association, Inc., and the latest edition of the ASHRAE Guide.

C. All duct sizes shown are net inside clear dimensions. Where internal duct lining is used, increase duct sizes accordingly to provide the indicated net free area. Unless otherwise indicated size runouts, drops, and connections to grilles, registers, diffusers, fans, louvers, and other equipment to the full size of the equipment connection.

D. Minor changes may be made in duct sizes where required to fit the available space, provided the indicated net free area and approximate aspect ratio are maintained.

E. Smoothly transition all ductwork to prevent excessive or unnecessary turbulence or pressure loss.

F. All exposed ductwork in finished areas shall be painted in color as indicated by the Owner. All ductwork requiring paint shall be constructed of paint grade galvanized sheet steel or aluminum with a paintable finish.

1.2. REFERENCES

A. ASTM A 36 - Structural Steel

B. ASTM A 90 - Weight of coating on Zinc-Coated (Galvanized) Iron or Steel Articles

C. ASTM C 916 Type II – Standard Specification for Adhesives for Duct Thermal Insulation

D. ASTM A 366 - Steel, Sheet, Carbon, Cold Rolled, Commercial Quality

E. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

F. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality

G. ASTM A 568 - Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled

H. ASTM A 569 - Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality

I. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate

J. AWS D9.1 - Welding of Sheet Metal

K. NFPA 90A - Installation of Air Conditioning and Ventilating Systems

L. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems

M. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.

N. SMACNA - HVAC Air Duct Leakage Test Manual

O. UL 181 - Factory-Made Air Ducts and Connectors.

P. NFPA 90A - Installation of Air Conditioning and Ventilating Systems

Q. NFPA 70 - National Electrical Code

R. SMACNA - HVAC Duct Construction Standards - Metal and Flexible

1.3. PERFORMANCE REQUIREMENTS

A. No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE Table of Equivalent Rectangular and Round Ducts.

1.4. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the projects specified in this section with minimum five (5) years documented experience.

B. Installer: Company specializing in performing the work of this section with minimum five (5) years' experience.

1.5. REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA- 90A.

1.6. ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturer.

B. Maintain temperatures during and after installation of duct sealants.

1.7. ALTERNATES

A. Refer to Division 01 Section 01 23 00 "Alternates" for description of work under this section affected by alternates.

PART 2. PRODUCTS

2.1. DUCTWORK

A. Unless otherwise indicated or specified, fabricate ductwork of galvanized sheet steel, stainless steel, or aluminum conforming to Commercial Designation 3003 Temper H14 and Duct Sheet. Duct gages, jointing and reinforcement shall conform to Tables 4, 5, 6

and 7, as applicable, Chapter I of the latest ASHRAE Guide and Data Book. Construction details shall conform to Section I and Section II, as applicable, of Duct Manual and Sheet Metal Construction for Ventilation and Air Conditioning Systems as published by Sheet Metal and Air Conditioning Contractors' Association, Inc.

B. Erect sheet metal ductwork in a first-class, workmanlike manner secured in place rigidly and permanently. Provide suitable hangers, securely attached to building construction with bolts, clips or inserts. Hangers shall be structural shapes, flat bars, or formed strap hangers; use of wire will not be permitted. Hangers shall not pass through or be inside duct. Support vertical ducts passing through floors by angles riveted to duct and resting either on floor or on brackets secured to building construction. All space around ducts where they pass through any walls, floors, ceilings, or roofs shall be sealed tight with incombustible inert material. Do not arrange ducts so as to impair the effectiveness of fireproofing around structural members. Provide sheet metal flanged collars around exposed ducts passing through walls, floors, or ceilings to provide finished appearance. Seal all duct joints and seams including supply, return, outside air, combustion air, relief air, ventilation air and exhaust ductwork with Hardcast Sealing System as manufactured by Hardcast, Inc., Foster, Childers, or approved equal.

C. Flexible connections of neoprene or other NFPA approved non-inflammable fabric shall be provided in the duct system at all fan inlet and outlet connections.

D. Provide cut turning vanes in all duct turns where centerline radius is located. Turning vanes shall be air-foil type with extended trailing edges. Fabricate to comply with SMACNA Sheet Metal Construction for Ventilation and Air Conditioning Systems Manual.

E. Provide duct collars and angle iron framework for mounting of automatic dampers.

F. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

G. Construct T’s, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide air foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

H. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

I. Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints shall be minimum 4-inch (100 mm) cemented slip joint, brazed or electric welded. Prime coat welded joints.

J. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

K. Fasteners: Rivets, bolts, or sheet metal screws.

L. Hanger Rods: ASTM A36 - Galvanized steel; threaded both ends, threaded one end, or continuously threaded.

2.2. DUCT SYSTEMS

A. All exhaust ductwork shall be constructed for low pressure service (2 inch W.G.).

2.3. DUCT CONSTRUCTION

A. Rectangular and/or Round Ductwork (Low Pressure):

1. Galvanized Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G-90 Zinc coating in conformance with ASTM A90.
2. Make allowance for internal duct lining where required. Sizes shown on the drawings are inside clear dimensions.
3. Determine duct gauges for the longest duct side and use for all four sides. Joints and reinforcing requirements apply to the longest duct side.
4. Reinforce all ducts to prevent buckling, vibration, or noise as recommended in the referenced construction standards, and as required to suit the installed conditions.
5. Do not cross break duct which will receive rigid insulation covering.
6. Where tap sizes of divided-flow fittings are not indicated, make branch and main/connection sizes proportional to their respective air flows and maintain uniform transverse velocities in the fitting.
7. Make radius elbows and radius tee connection with throat radius equal to or greater than the width of the duct. Use vaned elbows where shown and where radius elbows will not fit the space, and in all square bends.
8. Turning vanes shall be the air-foil type with extended trailing edges, 36-inch maximum vane length. Where longer vanes are required, use two or more sets of vanes with intermediate runners securely fastened together.
9. Bolt, screw, rivet, or spot weld reinforcing members securely to the duct on not less than 6-inch centers.
10. Where ducts are open-ended without grilles, registers, or other means of stiffening, reinforce and stiffen the open end with standing seams or an angle frame. Provide rolled edges to prevent any exposed sharp edges.
11. Paint all cut ends on galvanized angles, rods, and other uncoated surfaces with aluminum paint.
12. Where ductwork is not painted or otherwise finished, remove all exposed traces of joint sealers, manufacturer's identification and other markings.
13. Aluminum sheet shall be 3003 H14 alloy or duct sheet, 16,000 psi minimum tensile strength, and capable of being formed to a Pittsburgh lock seam.
14. Reinforcing members for aluminum ductwork shall be galvanized steel or aluminum unless otherwise indicated. Where aluminum reinforcing is used, size the member in accordance with ASHRAE recommendations to have rigidity

equivalent to listed mild steel angle sizes.

15. Where aluminum ductwork is used, make allowance for increased thermal expansion. Particularly avoid direct contact between aluminum and concrete or masonry walls subject to dampness.

16. Determine duct gauges per SMACNA based on duct size and pressure indicated.

B. Aluminum Ducts: ASTM B209, aluminum sheet, alloy 3003-H14. Aluminum connectors and bar stock: Alloy 6061-T6, or of equivalent strength stainless steel ducts: ASTM A167, Type 316.

C. Ductwork shall be 20 gauge aluminum construction where concealed and 18 gauge Type 316 stainless steel where exposed.

D. Ducts shall be constructed for low pressure operation with all seams liquid tight.

E. Provide a cleanout door of the same material as the ductwork for inspection and cleaning of interior duct surface. Cleanout shall be located in the vertical riser.

2.4. AIR VOLUME CONTROLS

A. Motor-operated dampers shall be as hereinafter specified under Division 23 Section 23 09 00 “Instrumentation and Control for HVAC”.

B. Duct turning vanes shall be Tuttle & Bailey Ducturns, or approved equal.

C. Furnish and install duct collars and angle iron frames for the installation of ATC dampers.

2.5. INSTRUMENT TEST PORTS

A. Furnish and install instrument test ports in the ductwork to allow use of pitot tube length. Equip holes with Ventlok #699 instrument ports. Fittings shall extend beyond duct covering and insulation.

2.6. DUCT ACCESS DOORS

A. Furnish and install adequately sized duct access doors at motor-operated dampers, and other locations where indicated and required for duct access. Doors shall be the continuous piano-hinged type with approved latches and neoprene compression-type gaskets with 1 inch thick fiberglass double skin and shall be Ruskin Model ADH22, Air Balance, Inc., FSA-100 or as approved equal. Stiffen ductwork at door openings. Where doors are installed in insulated ductwork, provide equivalent insulation in the door assembly. Where access doors are installed in the fire-rated partitions, provide Fire Seal access doors as manufactured by Air Balance, Inc., or approved equal, UL approved, meeting the rating of the enclosure in which the access door is installed.

B. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

2.7. DUCT LINING (LOW PRESSURE DUCTWORK)

A. All low pressure ductwork within 10 feet of exhaust air fans and as additionally shown on

Contract Drawings shall be lined on the interior for sound attenuation and thermal insulation.

B. All internal duct lining for low pressure duct systems shall be provided with an interior galvanized perforated liner.

C. The lining insulation shall be 1 inch thick, 3.0 pcf density, Aeroflex plus Duct Liner Type 300, Owens Corning Quiet R Rotary Duct Liner, Manville, Knauf, or approved equal. The material shall be specifically designed for this application, shall have a black, fire-resistant coating, shall meet NFPA Standards 90A and 90B and shall have a UL Fire Hazard Classification of Flame Spread 25 or less and smoke developed of 10 or less. The black-coated surface shall face the air stream.

D. All exposed edges and the leading edge of all cross joints of the liner shall be coated with the same adhesive used to secure the duct liner to metal surface. All air stream surfaces shall be treated with EPA registered fungicide Foster 40-20. Coating shall meet ASTM D 5590 with 0 growth rating.

E. The duct liner shall be adhered to the metal with 100 percent coverage of adhesive. Adhesive shall conform to Adhesive and Sealant Council Standards for adhesives for duct liner; ASTM C916, Type II (ASC-A-7001-A-1971). Adhesive shall be Foster 85-60, Childers CP-127 or approved equal.

F. The duct liner shall be additionally secured with mechanical fasteners, which shall compress the duct liner sufficiently to hold it firmly in place. Mechanical fasteners shall conform to Mechanical Fastener Standard MF-1-1971, available from Sheet Metal and Air Conditioning Contractors National Association.

G. All duct lining shall be installed in complete accordance with the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Duct Liner Application Standard, First Edition and Green Guard Indoor Air Quality certification program requirements.

H. Dimensions on drawings indicate inside clear opening of rectangular ductwork. Increase duct dimensions 2 inches each way for accommodating insulation on all shop or field-fabricated rectangular ductwork where lining is specified.

2.8. OPEN END DUCTS (OED)

A. Whether indicated on plans or not, all open-ended ducts shall be provided with a protective screen.

B. All open-ended ducts shall be furnished with a 12 gauge ½ inch x ½ inch aluminum mesh screen. Screens shall be permanently installed in a removable frame, and the frame shall be attached to the open-ended duct in a neat, workmanship-like manner without any exposed edges or sharp surfaces.

C. Screen shall be attached to a ¾ inch x 1/8 inch continuous galvanized perimeter frame. Install duct stiffeners greater than 16 inches in any direction at open-ended ducts.

2.9. DRIP PANS

A. Furnish and install suitable watertight, aluminum drip pans where water or drain piping is routed over electrical switchgear, transformers, computers, elevator machine equipment, dry storage rooms, etc. Each drip pan shall have a 1 inch copper type M drain piped to discharge where shown on drawings; or, if not shown, to discharge over nearest available open drain. Size and arrangement shall be as approved by Engineer. Sides shall be minimum 1.5 inches deep.

B. Drain pans shall be of 16 gauge welded construction. Provide drawings of typical drain pan construction for approval before construction. See Submittals in Division 01 Section 01 60 00 "Product Requirements".

2.10. DUCT SEALANTS AND ADHESIVES

A. All ductwork shall be sealed, including low pressure exhaust systems. Transverse joints and longitudinal seams in duct systems shall be sealed with a duct sealant of the type specified hereinafter in Section 1, 2, or 3, or with a tape sealing system as specified in Section 4. Spiral lockseams are not longitudinal seams and do not require duct sealant. All seams and joints shall require duct sealant suitable for the pressure rating and installation application. All sealants shall exceed 500 hours without becoming brittle under ASTM-D572 test conditions (oxygen bomb), unless specified otherwise. No surface preparation or solvent cleaning shall be necessary to remove light coatings of oil and dust before applying sealant unless specified otherwise. Flanged joints shall be sealed according to Section 5. Construction joints that are not fully welded shall be sealed according to Section 6. Adhesive to secure insulation to metal surfaces shall be that specified in Section 7.

1. Assembly joints to be installed indoors or outdoors shall be sealed with Foster 32-19, Childers CP-146, United Duct Sealer WB, or equivalent, which is a water-based sealant formulated to withstand service temperatures from 20 degrees F to +200 degrees F. Sealant shall have a UL Classification marking with a flame spread of 15 and smoke developed of 0 when applied to inorganic reinforced cement board, both at a coverage of 31 square feet per gallon. Store and apply between 40°F (4°C) and 100°F (38°C); protect from freezing.

2. Assembly joints to be installed indoors shall be sealed with Foster 32-19, childers CP-146, UNI-GRIP™ duct sealer or equivalent, which is a water-based (vinyl-acrylic polymer) sealant formulated to withstand temperatures from –20 degrees to +200 degrees Fahrenheit. Surfaces to be sealed should be clean, dry, and free from oil, grease, and dirt. Sealant shall be nonflammable (wet) and fire retardant. Sealant shall have a UL Classification marking with a flame spread of 5 and smoke developed of 5 when applied to 18-gauge galvanized steel and a flame spread of 0 and smoke developed of 0 when applied to inorganic reinforced cement board, both at a coverage of 40 square feet per gallon.

3. Assembly joints shall be sealed with UNI-CAST® tape sealing system or equivalent, which is a combination of an adhesive activator and woven-fiber tape impregnated with a gypsum mineral compound. Modified acrylic/silicone activator (MTA-20 for indoor use) reacts exothermically with the tape to form a hard, airtight seal. Sealant shall be formulated to withstand temperatures from –40 degrees F to +200 degrees Fahrenheit. Combination of tape and MTA-20 adhesive shall have a flame spread and smoke developed of 0. Do not use for outdoors.

4. Flanged joints to be installed indoors shall be sealed with UNI-GASKET™ flange sealer or equivalent, which has a synthetic elastomer base and is formulated to withstand temperatures from –20 degrees F to +150 degrees F. Sealant shall have a UL Classification marking with a flame spread of 5 and smoke developed of 5 when applied to 18-gauge galvanized steel and a flame spread of 0 and smoke developed of 5 when applied to inorganic reinforced cement board, both at a coverage of 80 square feet per gallon.

5. Where duct fittings are constructed with standing seam or spot-welded techniques, all construction joints shall be sealed with UNI-WELD™ metal cement or equivalent, which is composed of neoprene rubber, resins, and inert reinforcing material dispersed in a petroleum distillate. Sealant shall be formulated to withstand temperatures from –20 degrees F to +225 degrees F. Sealant shall have a UL Classification marking with a flame spread of 0 and smoke developed of 0 when applied to 18-gauge galvanized steel and a flame spread of 0 and smoke developed of 0 when applied to inorganic reinforced cement board, tested as applied in two 1/8 inch beads 8 inches on center.

6. Where insulation is to be secured to metal surfaces, the adhesive used shall be Foster 85-60, Childers CP-127, UNI-TACK™ duct liner adhesive or equivalent, which are water-based, vinyl-acrylic copolymer adhesives formulated to withstand temperatures from –20 degrees Fahrenheit to +200 degrees Fahrenheit. Adhesive shall have a UL Classification marking with a flame spread of 0 and smoke developed of 0 when applied to 18-gauge galvanized steel and a flame spread of 0 and smoke developed of 0 when applied to inorganic reinforced cement board, both at a coverage of 267 square feet per gallon. Adhesive shall conform to ASTM C916, Type II.

B. Manufacturers: Duct Mate, United McGill, MKT Metal Manufacturers, Semco, Elgen, Childers, Foster, or as approved equal.

PART 3. EXECUTION

3.1. DUCT INSTALLATION REQUIREMENTS

A. Coordinate ductwork with other work and install ducts at proper elevations and locations to maintain indicated ceiling heights and clearances. Provide all elbows, transitions, offsets, connections, and other fittings necessary to fit the work into place or to connect to equipment or diffusers. Method of duct support connection to structure and slabs shall be approved by Structural Engineer, and Shop Drawings shall be submitted.

B. Substantially support ductwork with structural shapes, flat bars, or formed strap hangers securely attached to the building structure by means of bolts, clamps, or inserts. Support vertical ducts by angles attached to the duct and resting on the floor or supported by brackets or hangers attached to the building structure. Strap hangers shall be 16-gauge minimum galvanized steel formed under the bottom edge of duct. Use square ¼ inch thick washers tight against the bend on upper strap attachments to horizontal surfaces. Place all supports external to the ductwork and out of the air stream. Provide additional supports at coils and other concentrated loads. Arrange supports so that duct weight is not transmitted to ceilings, fans or other equipment.

C. Prevent direct contact between ductwork and building surfaces or other equipment. Where ducts pass through walls, partitions, floors, ceilings, or roofs, pack and seal the

space around the duct with an approved fire-safe inert material. Provide flanged duct escutcheons at all exposed ducts that pass through walls, partitions, floors, and ceilings.

D. Use galvanized (compatible) corrosion-resistant hangers, supports, brackets, and hardware.

E. Furnish and install NFPA-approved duct connections where shown and at all connections to fans, air handling units, and similar rotating equipment. Use glass-reinforced neoprene fabric, roll-formed to sheet metal strips or flanges. Support adjacent ductwork to provide sufficient slack in the connection.

F. See NFPA 90A, and latest publication of SMACNA. Prevent direct contact between ductwork and building surfaces or other equipment. The opening in the construction around the duct shall not exceed one-inch average clearance on all sides. Where ducts pass through walls, partitions, floors, ceilings, or roofs, pack and seal the space around the duct with an approved fire-safe inert material capable of preventing the passage of flame and hot gases sufficiently to ignite cotton waste when subjected to the same NFPA 251 Time-Temperature Conditions required for fire barrier penetration. All exposed duct penetrations shall be finished with a sheet metal field erected flange escutcheon to form a neat appearance.

G. Coordinate duct installation with the requirements of Division 23 Section 23 05 48 “Vibration and Seismic Controls for HVAC Piping and Equipment”.

H. Install in accordance with manufacturer’s instructions.

I. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

J. Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.

K. Provide openings in ductwork where required to accommodate controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

L. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

M. Use double nuts and lock washers on threaded rod supports.

N. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork systems.

3.2. ACCESSORY INSTALLATION REQUIREMENTS

A. Install accessories in accordance with manufacturer’s instruction, NFPA 90A, and SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Provide duct access doors for inspection and cleaning before and after automatic dampers, and elsewhere as indicated. Review locations prior to fabrication.

C. Provide duct test holes where required for testing and balancing purposes. Review locations with Test and Balance Engineer prior to installation.

D. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment and supported by vibration isolators. Refer to Division 23 Section 23 05 48 “Vibration and Seismic Controls for HVAC Piping and Equipment”.

E. Install duct accessories according to applicable details shown in SMACNA's HVAC Duct Construction Standards Metal and Flexible for metal ducts.

F. Provide test holes at fan inlet and outlet and elsewhere as indicated.

G. Adjust duct accessories for proper settings.

3.3. DUCT LINING INSTALLATION REQUIREMENTS

A. All portions of duct designated to receive duct liner shall be completely covered with duct liner. Transverse joints shall be neatly butted and there shall be no interruptions or gaps. The black pigmented or mat faced surface of the duct liner shall face the airstream.

B. Duct liner shall be adhered to the sheet metal with 90 percent coverage of adhesive complying with requirements of ASTM C916. All exposed leading edges and transverse joints shall be factory coated or coated with adhesive during fabrication. Install perforated galvanized inner liner where indicated

C. Duct liner shall be additionally secured with mechanical fasteners, either weld-secured or impact-driven, which shall compress the duct liner sufficiently to hold it firmly in place. Adhesive bonded pins are not permitted due to long term adhesive aging characteristics. Spacing of mechanical fasteners with respect to duct liner interior width shall be in accordance with SMACNA HVAC DGS. Maximum spacing for mechanical fasteners shall be as follows:

Velocity = 0 to 2,500 feet per minute (0 to 12.8m/s):	
From transverse end of liner	3: (75mm)
Across width of duct	12 inches (300 mm) O.C.
From corners of duct	4 inches (100mm)
Along length of duct	18 inches (450mm) O.C.

Velocity = 2,501 to 5,000 feet per minute (12.8 to 25.4 m/s):	
From transverse end of liner	3 inches (75m)
Across width of duct	6 inches (150mm) O.C.
From corners of duct	4 inches (100mm)
Along length of duct	16 inches (400mm) O.C.

D. When air velocities exceed 4,000 fpm (20.3m/s), galvanized sheet metal nosing shall be applied to all leading edges of duct liner.

E. Acoustical Duct Liner shall be cut to assure overlapping and compressed longitudinal corner joints.

F. Upon completion of installation of duct liner and before operation is to commence, visually inspect the system and verify that the duct liner insulation has been correctly installed.

G. Open all system dampers and turn on fans to blow all scraps and other loose pieces of material out of the duct system. Allow for a means of removal of such material.

H. Check the duct system to ensure that there are no air leaks through joints.

3.4. CLEANING

A. Clean duct system and force air at high velocity through ducts to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

B. Clean duct systems with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

C. Ductwork shall be cleaned in accordance with “Duct Cleanliness for New Construction (SMACNA 2000)”, and shall achieve a “Basic” cleanliness level.

3.5. LEAKAGE TESTS

A. All low pressure sheet metal ductwork shall undergo leakage tests at 2 inch W.G. Tests shall be accomplished under this section and witnessed as specified under Division 23 Section 23 05 93 “Testing, Adjusting, and Balancing for HVAC”.

B. Leakage from each duct system shall not exceed 5 percent for low pressure systems of the normal air handling capacity of the system. If the system ductwork is tested in sections, the leakage shall not exceed ½ of 1 percent of the CFM to be handled by that section, and the total leakage of the system shall not exceed 1 percent of the total system CFM. Test pressure shall not exceed the pressure limits of the duct construction as defined in SMACNA High Pressure Duct Construction Standards. Repair all leaks which are audible, regardless of the leakage rate of the duct system as a whole, by remaking the entire defective joint or seam. Spot sealing of ducts in place will not be acceptable.

C. All duct accessories, including but not limited to motor operated dampers, duct access doors, ATC sensors, shall be installed prior to duct leakage testing.

D. Submit a complete report of the ductwork leakage tests to the Engineer and include final approved copies in test and balance reports.

3.6. DUCTWORK IDENTIFICATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. All ductwork shall be identified with painted background marked with the name of the service with arrows to indicate flow direction. Color Code and System Identification shall comply with ANSI Standards.

C. Marking shall be plain block letters, stenciled on ductwork and shall be located near each branch connection and at least every ten feet on straight runs of ductwork. Where ductwork is aligned adjacent to each other, markings shall be neatly lined up. All markings shall be located in such a manner as to be easily legible from the floor.

D. Identify ductwork with plastic nameplates or stenciled painting. Identify with exhaust fan unit identification and area served.

E. Length of color field for ductwork shall be 32 inches. Lettering shall be minimum 3-1/2 inches high.

END OF SECTION

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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.

1.2. ALTERNATES

A. Refer to Division 01 Section 01 23 00 “Alternates” for description of work under this Division affected by Alternates.

1.3. SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.

2. Sleeves for raceways and cables.

3. Grout.

4. Common electrical installation requirements.

B. Provide all labor, materials, equipment, and services necessary for and incidental to the complete installation and operation of all electrical work.

C. Unless otherwise specified, all submissions shall be made to, and acceptances and approvals made by the Architect and the Engineer.

D. Contract Drawings are generally diagrammatic and all offsets, fittings, transitions and accessories are not necessarily shown. Furnish and install all such items as may be required to fit the work to the conditions encountered.

E. Arrange conduits, equipment, and other work generally as shown on the Contract Drawings, providing proper clearance and access. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawings for approval in accordance with Article “Submittals” specified below. The right is reserved to make reasonable changes in location of equipment, boxes, conduit/wiring, and devices, up to the time of rough-in or fabrication.

F. Conform to the requirements of all rules, regulations and codes of local, state and federal authorities having jurisdiction.

G. Coordinate the work under Division 26 with the work of all other construction trades.

H. Be responsible for all construction means, methods, techniques, procedures, and phasing sequences used in the work. Furnish all tools, equipment and materials necessary to

properly perform the work in first class, substantial, and workmanlike manner, in accordance with the full intent and meaning of the Contract Documents.

1.4. CONTRACTOR QUALIFICATION

A. Any Contractor or Subcontractor performing work under Division 26 shall be fully qualified and acceptable to the Architect/Engineer and Owner. Submit the following evidence when requested:

1. A list of not less than five comparable projects which the Contractor completed.

2. Letter of reference from not less than three registered professional engineers, general contractors or building owners.

3. Local and/or State License, where required.

4. Membership in trade or professional organizations where required.

5. Copy of Master Electrician's License.

B. A Contractor is any individual, partnership, or corporation, performing work by contract or subcontract on this project.

C. Acceptance of a Contractor or Subcontractor will not relieve the Contractor or subcontractor of any contractual requirements or his responsibility to supervise and coordinate the work, of various trades.

D. Supervisory Qualifications: The electrical work on the project shall be under the direct supervision of a licensed Master Electrician.

E. Qualifications of Installers:

1. For the actual fabrication, installation, and testing of the work, shall use only thoroughly trained and experienced personnel who are completely familiar with the requirements of this work and with the installation recommendations of the manufacturers of the specified items.

2. Utilize a full time project foreman in charge of all electrical work. This person shall be fully qualified and experience in such work and shall be available, on site, at all times during Construction. All problems, questions, coordination, etc. related to electrical work shall take place through this person to the Architect.

1.5. PERMITS, FEES, AND INSPECTIONS

A. Obtain all permits and pay taxes, fees and other costs in connection with the work. File necessary plans, prepare documents, give proper notices and obtain necessary approvals. Deliver inspection and approval certificates to Owner prior to final acceptance of the work.

B. Permits and fees shall comply with Division 01 Section, General Requirements.

C. Notify Inspection Authorities to schedule inspections of work.

D. Notify Engineer in advance of scheduled inspections.

E. An electrical foreman, superintendent or other supervisor shall be in attendance for all scheduled inspections.

1.6. EXAMINATION OF SITE

A. Examine the site, determine all conditions and circumstances under which the work must be done, and make all necessary allowances for same. No additional cost to the Owner will be permitted for Contractor's failure to do so.

B. Examine and verify specific conditions described in individual Specifications sections.

C. Verify that utility services are available, of the correct characteristics, and in the correct locations.

1.7. INTERPRETATION OF DOCUMENTS

A. Any discrepancies between Drawings, Specifications, Drawings and Specifications, or within Drawings and Specifications shall be promptly brought to the attention of the Owner during the bidding period. No allowance shall subsequently be made by reason of failure to have brought said discrepancies to the attention of the Owner during the bidding period or of any error on the Bidder's part.

B. The locations of products shown on Drawings are approximate. Place the devices to eliminate all interference with overhead ducts, piping, etc. Where any doubt exists, the exact location shall be determined by the Owner.

C. No electrical equipment, e.g. panelboards, disconnect switches, motor controllers, etc. shall be installed beneath ductwork, piping, etc.

D. All general trades and existing conditions shall be checked before installing any outlets, power wiring, etc.

E. Equipment sizes shown on the Drawings are estimated. Before installing any wire or conduit, obtain the exact equipment requirements and install wire, conduit, or other item of the correct size for the equipment actually installed. However, wire and conduit sizes shown on the Drawings shall be taken as a minimum and shall not be reduced without written approval from the Owner.

F. Where variances occur between the Drawings and Specifications or within either document itself, the item or arrangement of better quality, greater quality, or higher cost shall be included in the Contract Price. The Engineer will decide on the item and manner in which the work shall be installed.

G. Contract Drawings are generally diagrammatic and all offsets, fittings, transitions, and accessories are not necessarily shown. Furnish and install all such items as may be required to fit the work to the conditions encountered. Arrange conduits, equipment, and other work generally as shown on the Contract Drawings, providing proper clearance and access. Where departures are proposed because of field conditions or other causes, prepare and submit detailed Shop Drawings for approval in accordance with Article "Submittals" as

herein after specified. The right is reserved to make reasonable changes in location of equipment, conduit/wiring, and devices, up to the time of rough-in or fabrication.

H. Work not specifically outlined, but reasonably incidental to the completion of the work, shall be included without additional compensation from the Engineer and Owner.

I. Perform the work in a first-class, substantial and workmanlike manner. Any materials installed which do not present an orderly and neat workmanlike appearance shall be removed and replaced when so directed by the Engineer, at the Contractor's expense.

J. The complete set of Mechanical and Electrical Drawings and Specifications apply to this work. The successful Bidder shall familiarize himself with all other related documents.

1.8. MATERIALS AND EQUIPMENT

A. Materials and equipment installed as a permanent part of the project shall be new, unless otherwise indicated or specified, and of the specified type and quality.

B. Where material or equipment is identified by proprietary name, model number and/or manufacturer, furnish named item, or its equal, subject to approval by Engineer. Substituted items shall be equal or better in quality and performance and must be suitable for available space, required arrangement, and application. Submit all data necessary to determine suitability of substituted items, for approval.

C. The suitability of named item only has been verified. Where more than one item is named, only the first named item has been verified as suitable. Substituted items, including items other than first named shall be equal or better in quality and performance to that of specified items, and must be suitable for available space, required arrangement and application. Contractor, by providing other than the first named manufacturer, assumes responsibility for all necessary adjustments and modifications necessary for a satisfactory installation. Adjustments and modifications shall include but not be limited to electrical, structural, support, and architectural work.

D. Substitution will not be permitted for specified items of material or equipment where noted.

E. All items of equipment furnished shall have a service record of at least five (5) years.

1.9. ELECTRICAL WORK UNDER OTHER DIVISIONS

A. HVAC Equipment and Systems

1. In general, any electrically operated or controlled equipment furnished under HVAC divisions shall be supplied with control wiring, transformers, contacts, etc.

2. Division 26 shall provide power circuits to such equipment and a disconnecting means for each piece of equipment, as well as all electrical control equipment and wiring related thereto.

3. Certain mechanical units are furnished from the factory with motor starters, contactors, transformers, fuses, wiring, etc., required for fans, pumps, etc. When this equipment is supplied from the factory, Division 26 shall coordinate with

Division 23 such that only one set of starters, fuses, switches, etc. is provided.

4. Some HVAC equipment must be protected by fuses, which shall be marked on the equipment nameplate. In these instances, if the equipment has an integral non-fused disconnecting means, the fusible safety switch indicated on the electrical drawings must remain per NEC Article 440.

5. In general, control and interlock equipment (including, but not limited to wiring, conduit, transformers, relays, contacts, etc.) for HVAC equipment and systems is furnished under Division 23. Division 26 shall install and connect all equipment as necessary.

6. HVAC equipment refers to, but is not limited to the following:

    a. Chiller
    b. Cooling Tower
    c. ATC Panels
    d. Ductwork
        i. Do not install any electrical equipment, including but not limited to panelboards, safety switches, motor controllers, etc. beneath ductwork. Where this cannot be accomplished due to field conditions, notify the Engineer in writing.
    e. Condenser Water Pump
    f. Variable Frequency Drives
    g. Exhaust Fans

7. To ensure proper electrical coordination between the electrical components supplied under Division 26 and the equipment supplied under Division 23, a schedule shall be submitted, prior to start of work, for review by the Engineer with the following column headings:

    a. Equipment or Item
    b. HP or KVA
    c. Voltage and Phase
    d. Power Factor
    e. Capacitor
    f. Motor Starter
    g. Disconnect
    h. Controls
    i. Remarks

1.10. FIRE SAFE MATERIALS

A. Unless otherwise indicated, materials and equipment shall conform to UL, NFPA and ASTM standards for fire safety with smoke and fire hazard rating not exceeding flame spread of 25 and smoke developed of 50.

1.11. REFERENCED STANDARDS, CODES AND SPECIFICATIONS

A. Specifications, Codes and Standards listed below are included as part of this Specification,

latest edition:

1.	ADA	-	Americans with Disabilities Act
2.	ANSI	-	American National Standards Institute
3.	ASTM	-	American Society for Testing and Materials
4.	CSA	-	Canadian Standards Association
5.	DNREC	-	Delaware Department of Natural Resources and Environmental Control
6.	FM	-	Factory Mutual
7.	IBC	-	International Building Code
8.	IEEE	-	Institute of Electrical and Electronics Engineers
9.	NEC	-	National Electrical Code
10.	NECA	-	National Electrical Contractors Association
11.	NEMA	-	National Electrical Manufacturers Association
12.	NFPA	-	National Fire Protection Association
13.	OSHA	-	Occupational Safety and Health Act
14.	UL	-	Underwriters' Laboratories

B. Electrical construction materials shall, where a listing is normal for the particular class of material, be listed in Electrical Construction Materials List of the Underwriters' Laboratories, Inc. (U.L.) and shall bear the listing label. Electrical equipment shall, where a listing is normal for the particular class of equipment, be listed in the Electrical Appliance and Utilization Equipment List of the Underwriters' Laboratories, Inc. (U.L.) and shall bear the listing label. Materials and equipment listed and labeled as "approved for the purpose" by other nationally recognized testing laboratory, inspection agency or approved organization (such as E.T.L. or Factory Mutual) shall be acceptable.

1.12. SUBMITTALS

A. Product Data: Include complete descriptive product data for items specified in Part 2 of this Section.

1.13. SUBMITTAL PROCEDURES

A. Refer to Division 01, Section 01 33 00 “Submittal Procedures” for requirements in addition to those indicated herein.

B. Equipment, materials, installation, workmanship and arrangement of work are subject to review and acceptance. No substitution will be permitted after acceptance of equipment or

materials except where such substitution is considered by the Engineer to be in the best interest of the Owner.

C. After acceptance of Material and Equipment List, submit six (6) copies, or more as required under the General Conditions, of complete descriptive data for all items as outlined below.

D. Electronic submittals shall be prepared as a Portable Document Format (PDF) file and shall include as page 1 the Contractor's stamp, followed by the submittal contents. Submittal form shall identify the Project, Contractor, Subcontractor or Supplier, and pertinent Contract Document references.

E. Submittals shall consist of specifications, product data sheets, manufacturer's catalog cuts, dimensional shop drawings, wiring diagrams, installation instructions, samples, and any other information necessary to indicate complete compliance with Contract Documents.

F. Submittals shall include, but not be limited to, the following information: size, type, functional characteristics, compliance with standards in Division 26, required service access which shall be suitable for intended location and use, electrical service connections and requirements, and deviations from Contract Document requirements.

G. Identify submittals, indicating intended application, location and service of submitted items. Refer to Specification sections or paragraphs and Drawings where applicable.

H. Clearly indicate exact type, model number, style, size, operating characteristics, ratings, options and special features of proposed item specifically for application to this project. Submittals of a general nature will not be acceptable.

I. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable. Call attention, in writing, to deviation from contract requirements.

J. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and all electrical requirements for equipment submitted. The Contractor shall be responsible for correctness of all submittals.

K. Submittals will be reviewed for general compliance with design concept in accordance with Contract Documents, but dimensions, quantities, or other details will not be verified.

L. For any submittal requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold Contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.

M. For substituted items, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The Contractor shall be responsible for corrective action and maintaining the Specification requirements if differences have not been clearly indicated in the submittal.

N. Where proposals to use an item of equipment or application other than that specified or detailed on the Contract Drawings, which requires any redesign of the structure, partitions,

foundation, HVAC, piping, wiring, or any other part of the mechanical, electrical, or architectural layout, all such redesign and all new drawings and detailing required thereafter shall be prepared by the Contractor at his own expense for review by the Owner's representative before any such work is implemented.

O. All Contractor-proposed changes and revisions shall be at the Contractor's risk and expense. The Contractor shall fully coordinate all revisions, substitutions and changes with other trades for a complete, code compliant, and fully functional installation.

P. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted. Use only final or corrected submittals and data prior to fabrication and/or installation.

Q. Every submittal including, but not limited to the list below, shall be forwarded with its own transmittal as a separate, distinct submittal. Identify all submittals by the name of the item/system and the applicable Specification Section and/or Drawing number. Grouping of items/systems that are not related shall be unacceptable.

R. Items and Systems

1. Circuit Breakers
2. Conductors and Cables - 600V or Less
3. Conduit and Raceway
4. Connectors and Splices
5. Disconnect (Safety) Switches
6. Electrical Connection Coordination Schedule
7. Equipment Nameplates/Labels
8. Firestopping Materials
9. Fuses, 600V or Less
10. Ground Conductors
11. Hangers and Supports
12. Identification Products
13. Junction and Pull Boxes
14. Motor Controllers
15. Operation and Maintenance Manual
16. Outlet and Device Boxes

17. Panelboard Circuit Directories

18. Panelboards

19. Record Drawings

20. Sleeves

21. Test Reports

22. Toggle/Snap Switches

23. Weatherproof Boxes and Covers

S. Submit for approval any other submittals as required by the Engineer or Owner. No item listed above shall be delivered to the site, or installed, until approved. After the proposed materials have been approved, no substitution will be permitted except where approved by the Engineer.

T. Prepare and submit a detailed schedule of values indicating the Contract costs for the major work items. Provide additional detail and information as requested by the Engineer.

U. For resubmissions, the Contractor must address in writing all of the Engineer's comments on the original submission to verify compliance.

1.14. DEFINITIONS

A. Approve: To permit use of material, equipment or methods conditional upon compliance with contract documents requirements.

B. Building Line: Exterior wall of building.

C. Concealed: Hidden from sight in chases, formed spaces, shafts, hung ceilings, or embedded in construction.

D. Conduits: Include conduit, all fittings, identification, and other accessories relative to such conduit.

E. Contractor: The Electrical Contractor and any of his subcontractors, vendors, suppliers, or fabricators.

F. EPDM: Ethylene-propylene-diene terpolymer rubber

G. Exposed: Not installed underground or concealed as defined above.

H. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceiling, unexcavated spaces, crawl spaces, and tunnels.

I. Furnish and install or provide: To supply, erect, install, and connect to complete for readiness for regular operation, the particular work referred to.

J. Location, Damp: Locations protected from water and not subject to saturation with water or other liquids, but subject to moderate degrees of moisture. Examples of such locations include interior locations such as basements, crawlspaces, attics, cold-storage rooms, etc…

K. Location, Dry: A location not normally subject to dampness or wetness. A dry location may temporarily be subject to dampness or wetness during building construction.

L. Location, Wet: Locations subject to saturation with water or other liquids, locations exposed to weather, and installations underground or in concrete slabs or masonry in direct contact with the Earth. Examples of such locations include all exterior locations (including those under canopies, roofed open area, etc.…).

M. NBR: Acrylonitrile-butadiene rubber.

N. Review: Limited observation or checking to ascertain general conformance with design concept of the work and with information given in contract documents. Such action does not constitute a waiver or alteration of the contract requirements.

1.15. RECORD DRAWINGS

A. Upon completion of the electrical installations, the Contractor shall deliver to the Engineer one complete set of prints of the electrical Contract Drawings which shall be legibly marked in red pencil to show all changes and departures of the installation as compared with the original design. They shall be suitable for use in preparation of Record Drawings.

B. Contractor shall incorporate all sketches, addendums, value engineering, change orders, etc., into record drawings prior to delivering the same to the Engineer.

1.16. WARRANTY

A. Contractor's attention is directed to warranty obligations contained in the General Conditions.

B. The above shall not in any way void or abrogate equipment manufacturer's guarantee or warranty. Certificates of equipment manufacturer’s warranties shall be included in the operations and maintenance manuals.

C. The Contractor guarantees for a two (2) year period from the time of final acceptance by the Owner:

1. That the work contains no faulty or imperfect material or equipment or any imperfect, careless, or unskilled workmanship.

2. That all work, equipment, machines, devices, etc. shall be adequate for the use to which they are intended, and shall operate with ordinary care and attention in a satisfactory and efficient manner.

3. That the Contractor will re-execute, correct, repair, or remove and replace with proper work, without cost to the Owner, any work found to be deficient. The Contractor shall also make good all damages caused to their work or materials in the process of complying with this section.

4. That the entire work shall be water-tight and leak-proof.

1.17. OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall have prepared six (6) hardcopies and one (1) electronic copy of the Operation and Maintenance Manual and deliver these copies of the manual to the Owner. The manual shall be as specified herein. The manual must be approved and will not be accepted as final until so stamped.

B. The manual shall be bound in a three ring loose-leaf binder similar to National No. 3881 with the following title lettered on the front and spine of the binder: Operation and Maintenance Manual – Delcastle High School Chiller/Cooling Tower Refurbishment - Electrical. No sheets larger than 8-1/2 inches x 11 inches shall be used, except sheets that are neatly folded to 8-1/2 inches x 11 inches and used as a pull-out.

C. Provide divider tabs and table of contents for organizing and separating information. Tab titling shall be clearly printed under reinforced plastic tabs.

1. If more than one (1) binder is required, volume numbers shall be included on front and spine of each volume.

D. Provide the following data in the manual:

1. As first entry, an approved letter indicating the starting/ending time of Contractor’s warranty period.

2. Directory listing names, addresses, e-mail addresses, and telephone numbers for, Engineer, Contractor, Sub-contractor(s), equipment suppliers, sales, and authorized service representatives.

3. Maintenance operation and lubrication instructions on each piece of equipment furnished.

4. Complete catalog data on each piece of electrical equipment furnished including approved Shop Drawing/Submittal with Engineer’s Comments (if any).

5. Manufacturer's extended limited warranties on equipment.

6. Catalog data of all equipment, starters, etc. shall include wiring diagrams, parts list and assembly drawing(s).

7. Access panel charts with index illustrating the location and purpose of access panels.

8. Approved Electrical Certificates, including certificate of approval from electrical inspector.

9. List of extra materials turned over to Owner, with transmittal/receipt signed by Owner.

10. Sign-in sheets from demonstration and training sessions.

11. Start-up and test reports for equipment.

E. Additional items identified within other Sections of these Specifications.

F. Submit Operation and Maintenance Manual prior to the anticipated date of Substantial Completion for Engineer review and approval. Substantial Completion requires that Operation and Maintenance Manuals be reviewed and approved.

1.18. INSTRUCTION

A. Upon completion of all work, thoroughly instruct the Owner's representatives in the proper operation and maintenance of all electrical equipment and systems.

B. Instructions shall be done only after completed systems have been put into operation and tested for proper operation and performance.

C. Instructions shall be given only by experts in the equipment or system and shall include descriptions and demonstrations of procedures of operation, data record keeping, etc.

D. Furnish the necessary technicians, skilled workers, and helpers to operate the electrical systems and equipment of the entire project for one (1) 8-hour day.

E. Where specified in technical sections, provide longer periods required for specialized equipment.

F. The Operation and Maintenance Manual shall be available at the time of the instructions, for use by Instructors and Owner personnel.

G. Deliver all instruction materials to the Owner prior to the formal instruction period.

H. Schedule the general and specialized instruction periods for a time agreed upon by the Owner and Engineer.

I. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

PART 2. PRODUCTS

2.1. SLEEVES FOR RACEWAYS AND 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.

2.2. GROUT

A. Nonmetallic, Non-Shrink Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3. EXECUTION

3.1. TEMPORARY FACILITIES

A. General: Refer to the Division 01 Sections for general requirements of temporary facilities.

B. Description: Furnish and install the necessary distribution equipment for an adequate temporary electrical service and all temporary wiring, including step-down or step-up dry-type transformers as required. Exact requirements for temporary service shall be determined by the successful bidder.

C. Attention is directed to the Occupational Safety and Health Act (OSHA), Americans with Disabilities Act (ADA) and National Electrical Code (NEC) requirements for electrical work on construction sites.

D. Materials:

1. Three (3) 20-ampere circuits with ground fault protection for each 7500 square feet of gross floor area per floor to which various trades may attach their cords.

E. Remove all temporary power installations and connections after permanent power is established and/or prior to completion of the project.

3.2. COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Install equipment with working space and dedicated space in strict accordance with NEC Article 110.

E. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

F. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

G. Verify exact electrical requirements for each piece of equipment receiving one or more electrical connections, including but not limited to voltage, phase, and maximum fuse/overcurrent protection device rating. Provide electrical circuit of proper characteristics to serve provided equipment.

H. Include any and all items required by the National Electrical Code and/or field conditions for the proper connection and installation of each piece of equipment.

I. Make all connections to equipment in accordance with manufacturer's instructions.

J. Right of Way: Give to piping systems installed at a required slope.

K. Coordinate electrical work under other Divisions in accordance with Part 1 of this Section, Article "Electrical Work Under Other Divisions".

3.3. SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used.

C. 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.

D. Cut sleeves to length for mounting flush with both surfaces of walls.

E. Sleeves installed in floors shall extend 2 inches (50 mm) above finished floor level unless otherwise indicated on the Contract Drawings.

F. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

G. Seal space outside of sleeves with grout for penetrations of concrete and masonry

H. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements of Division 07 Section 07 84 13 "Penetration Firestopping".

K. Aboveground, Exterior-wall Penetrations: Seal penetrations using steel sleeves and joint sealant/grout.

3.4. FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section 07 84 13 "Penetration

Firestopping".

3.5. SUPPORTS, HANGERS AND FOUNDATIONS

A. Provide supports, hangers, braces, attachments and foundations required for the work. Support and set the work in a thoroughly substantial and workmanlike manner without placing strains on materials, equipment, or building structure, submit shop drawings for approval. Coordinate all work with the requirements of the structural division.

B. Supports, hangers, braces, and attachments shall be standard manufactured items or fabricated structural steel shapes. All interior hangers shall be galvanized or steel with rust inhibiting paint. All exterior hangers shall be constructed of stainless steel utilizing stainless steel rods, nuts, washers, bolts, etc.

C. Refer to Division 26 Section 26 05 29 “Hangers and Supports for Electrical Systems” for additional requirements.

3.6. PAINTING AND FINISHES

A. Provide protective finishes on all materials and equipment. Use coated or corrosion-resistant materials, hardware and fittings throughout the work. Paint bare, untreated ferrous surfaces with rust-inhibiting paint. All exterior components including supports, hangers, nuts, bolts, washers, vibration isolators, etc. shall be stainless steel.

B. Clean surfaces prior to application of insulation, adhesives, coatings, paint, or other finishes.

C. Provide factory-applied finishes where specified. Unless otherwise indicated factory-applied paints shall be baked enamel with proper pretreatment.

D. Protect all finishes and restore any finishes damaged as a result of work under Division 26 to their original condition.

E. The preceding requirements apply to all work, whether exposed or concealed, as defined herein.

F. Remove all construction marking and writing from exposed equipment, conduit, boxes, and building surfaces. Do not paint manufacturer's labels or tags.

G. All exterior equipment and conduits shall be painted to match adjacent surface in color as selected by Owner, unless otherwise indicated by the Owner.

H. All exposed conduit, boxes, equipment, etc. in finished spaces shall be painted. Colors shall be as selected by the Owner and conform to ANSI Standards.

3.7. COLOR SELECTION

A. Color of finishes shall be as selected by the Owner.

3.8. PROTECTION OF WORK

A. Protect work, material and equipment from weather and construction operations before and after installation. Properly store and handle all materials and equipment.

B. Cover temporary openings in conduits and equipment to prevent the entrance of water, dirt, debris, or other foreign matter. Deliver conduits with factory applied end caps.

C. Cover or otherwise protect all finishes.

D. Replace damaged materials, devices, finishes and equipment.

E. Protect stored conduits from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, where stored inside.

3.9. OPERATION OF EQUIPMENT

A. Clean all systems and equipment prior to initial operation for testing, or other purposes. Lubricate, adjust, and test all equipment in accordance with manufacturer's instructions. Do not operate equipment unless all proper safety devices or controls are operational. Provide all maintenance and service for equipment that is authorized for operation during construction.

B. Where specified, or otherwise required, provide the services of the manufacturer's factory-trained servicemen or technicians to start up the equipment. Where factory start-up of equipment is not specified, provide field start-up by qualified technician.

C. Submit factory start-up sheets or field start-ups sheets for all equipment prior to the commencement of testing.

D. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items.

3.10. TESTING AND ADJUSTMENT

A. Perform all tests which are specified or required to demonstrate that the work is installed and operating properly. Where formal tests are required, give proper notices and perform all necessary preliminary tests to assure that the work is complete and ready for final test.

B. Adjust all systems, equipment and controls to operate in a safe, efficient and stable manner.

C. On all circuits, 600 volts or less, provide circuits that are free from ground faults, short circuits and open circuits.

D. Other tests of a specific nature for special equipment shall be as specified under the respective equipment.

E. Submit all test results to the Engineer for approval.

3.11. WALL AND FLOOR PENETRATIONS

A. All penetrations of partitions, ceilings, roofs and floors under Division 26 shall be sleeved, sealed, and caulked as specified herein.

B. All penetrations of fire rated assemblies shall be sleeved, sealed, caulked and protected to maintain the rating of the wall, roof, or floor. Fire Marshal approved U.L. assemblies shall be utilized. See Division 07 Section 07 84 13 “Penetration Firestopping”.

C. Provide conduit escutcheons for all exposed conduit penetrations in finished interior spaces and all exposed exterior penetrations.

D. Conduit sleeves:

1. Galvanized steel pipe, standard weight where pipes are exposed and roofs and concrete and masonry walls. On exterior walls provide anchor flange welded to perimeter.

2. Twenty-two (22) gauge galvanized steel elsewhere.

3.12. EQUIPMENT BY OTHERS

A. This Contractor shall make all system connections required to equipment furnished and installed under other divisions or furnished by the Owner. Connections shall be complete in all respects to render this equipment functional to its fullest intent.

B. It shall be the responsibility of the supplier of the equipment to furnish complete instructions for connections. Failure to do so will not relieve the Contractor of any responsibility for improper equipment operation.

3.13. OUTAGES

A. Provide a minimum of seven (7) days’ notice to schedule outages. The Contractor shall include in their bid outages and/or work in occupied areas to occur on weekends, holidays, or at night. Coordinate and get approval of all outages with the Owner.

B. Submit Outage Request Form, attached at the end of this Section, to Owner for approval.

3.14. CUTTING AND PATCHING

A. Accomplish all cutting and patching necessary for the installation of work under Division 26. Damage resulting from this work to other work already in place, shall be repaired at Contractor's expense. Where cutting is required, perform work in neat and workmanlike manner. Restore disturbed work to match and blend with existing construction and finish, using materials compatible with the original. Use mechanics skilled in the particular trades required.

3.15. PENETRATION OF WATERPROOF CONSTRUCTION

A. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls, and interior waterproof construction. Where such penetrations are necessary, furnish and install all necessary curbs, sleeves, flashings, fittings and caulking to make penetrations absolutely watertight.

3.16. CONCRETE AND MASONRY WORK

A. Furnish and install concrete and masonry work for equipment foundations, supports, pads, and other items required under Division 26. Perform work in accordance with requirements of Division 03 and other applicable Divisions of these Specifications.

B. Concrete shall achieve compressive strength not less than 3,000 psi after 28 days.

C. Grout shall be non-shrink, high strength mortar, free of iron of chlorides and suitable for use in contact with all metals, without caps or other protective finishes. Apply in accordance with manufacturer's instructions and standard grouting practices.

D. Properly align, level, and grout all equipment where necessary.

3.17. CONNECTIONS AND ALTERATIONS TO EXISTING WORK

A. Unless otherwise noted on the Drawings, where existing electrical work is removed, including hangers, to a point below finished floors or behind finished walls and capped, such point shall be far enough behind finished surfaces to allow for installation of normal thickness of required finish material.

B. Where work specified in Division 26 connects to existing equipment, conduits, etc., Contractor shall perform all necessary alterations, cuttings, fittings, etc., of existing work as may be necessary to make satisfactory connections between new and existing work, and to leave completed work in a finished and workmanlike condition.

C. Where the work specified under Division 26, or under other Divisions, requires relocation of existing equipment, conduit etc., Contractor shall perform all work and make necessary changes to existing work as may be required to leave completed work in a finished and workmanlike condition.

D. Where the relocation of existing equipment is required for access or the installation of new equipment, the Contractor shall temporarily remove and/or relocate and re-install as required to leave the existing and new work in a finished and workman like condition.

3.18. COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

2. To provide for ease of disconnecting the equipment with minimum interference to other installations.

3. To allow right of way for piping and conduit installed at required slope.

4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

5. To provide working space and dedicated space clearances per NEC Article 110.26.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section 07 84 13 "Penetration Firestopping".

3.19. DEMOLITION

A. Unless otherwise noted all existing equipment, conduit, wire, etc., shall remain.

B. Where existing equipment is indicated to be removed, all associated conduit, power, controls, insulation, hangers, supports and housekeeping pads, etc.…, shall also be removed. Patch, paint and repair walls/roof/floor to match existing and/or new finishes.

C. The Contractor shall be responsible for visiting the site and determining the existing conditions in which the work is to be performed.

D. Where any abandoned conduits in existing floors, walls, ceilings, etc., conflict with new work, and remove abandoned conduits as necessary to accommodate new work.

E. The location of all existing equipment, conduits etc., indicated is approximate only and shall be checked and verified. Provide all new electrical work required to connect to or clear existing work as applicable.

F. Maintain egress at all times. Coordinate egress requirements with the City of Wilmington Fire Marshal, the Owner and the Authority(ies) Having Jurisdiction (AHJ).

G. Where required to maintain the existing systems in operation, temporarily backfeed existing systems from new equipment. Contractor shall temporarily extend existing conduit systems to new conduit systems.

H. At completion of project all temporary conduit, wires, etc., shall be removed in their entirety.

I. Existing conduit, equipment, wiring, etc., not required for re-use or re-installation in this project, shall be removed from the project site.

J. Deliver to the Owner, on the premises where directed, existing equipment and materials which are removed and which are desired by the Owner or are indicated to remain the property of the Owner.

K. All other materials and equipment which are removed shall become property of the Contractor and shall be promptly removed, from the premises, and disposed of by the Contractor, in an approved manner. Contractor shall be responsible for proper disposal of all removed equipment containing PCB’s.

L. Where conduit and wiring are removed, remove all conduit hangers which were supporting the removed conduit. Patch the remaining penetration voids with like materials and paint to match existing construction.

M. Before demolition begins, and in the presence of the Owners representative, test and note all deficiencies in all existing systems affected by demolition but not completely removed by demolition. Provide a copy of the list of system deficiencies to the Owner and the Engineer.

N. The Owner shall have the first right of refusal for all fixtures, devices and equipment removed by the Contractor.

O. All devices and equipment designated by the Owner to remain the property of the Owner shall be moved and stored by the Contractor at a location on site as designated by the Owner. It shall be the Contractor's responsibility to store all devices and equipment in a safe manner to prevent damage while stored.

P. All existing equipment refused by the Owner shall become the property of the Contractor and shall be removed from the site by the Contractor in a timely manner and disposed of in a legal manner.

Q. Work Abandoned in Place: Cut and remove conduit a minimum of 2 inches beyond face of adjacent construction. Cap and patch surface to match existing finish.

R. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

END OF SECTION

OUTAGE REQUEST FORM

DATE APPLIED: _____ **BY:** _____

DATE FOR OUTAGE: _____ **FIRM:** _____

START OUTAGE-TIME: _____ **DATE:** _____

END OUTAGE - TIME: _____ **DATE:** _____

AREAS AND ROOMS: _____

FLOOR(S): _____

AREA(S): _____

ROOM(S): _____

WORK TO BE PERFORMED: _____

SYSTEM(S): _____

REQUEST APPROVED BY: _____

(FOREMAN OR OTHER PERSON IN CHARGE)

PART 1 (FOR OWNER'S USE ONLY):

APPROVED: _____

YES ____ **NO** ___ **BY:** _____ **DATE:** _____

DATE/TIME-AS REQUESTED: _____ **OTHER :** _____

OWNER'S PRESENCE REQUIRED: _____

YES: ____ **NO:** ___ **NAME:** _____

POINT OF CONTACT: _____ **PHONE:** _____

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LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
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SECTION 26 05 19
LOW VOLTAGE ELECTRICAL POWER CONDUCTORS 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 building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3. SUBMITTALS

A. Product Data: Provide for each cable assembly type, wire, cables, conductors, and connectors.

B. Project Record Documents: Record actual locations of components and circuits.

1.4. QUALITY ASSURANCE

A. Listing and Labeling: Provide wires and cables specified in this Section that are listed and labeled.

1. The Terms Listed and Labeled: As defined in NFPA 70, Article 100.

2. Listing and Labeling Agency Qualifications: A Nationally Recognized Testing Laboratory as defined in OSHA Regulation 1910.7.

B. Comply with NEMA/Insulated Cable Engineers Association (ICEA) Standards.

C. Comply with NECA Standard of Installation.

D. Comply with NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

E. American Society for Testing and Materials (ASTM): Comply with requirements of the following:

1. B3: Standard Specification for Soft or Annealed Copper Wire

2. B8: Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

3. D753: Standard Specification for General Purpose Polychloroprene Jacket for Wire and Cable

F. Electrical Testing Laboratories (ETL): Provide wiring, cabling and connector products which are ETL listed and labeled.

G. Institute of Electrical and Electronics Engineers (IEEE): Comply with the following standards which apply to wiring systems:

1. 82: Test procedure for Impulse Voltage Tests on Insulated Conductors

2. 241: Recommended Practice for Electric Power Systems in Commercial Buildings

H. NFPA: Comply with NFPA 70 requirements for construction, installation and color coding of electrical wire, cable and connections.

I. National Electrical Manufacturer's Association (NEMA): Comply with requirements of the following:

1. WC70: Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.

J. UL: Provide material conforming to the following standards:

1. UL 83 - Thermoplastic-Insulated Wires and Cables.

2. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors

K. UL Labels: Provide wiring, cabling and connector products which are UL listed and labeled.

1.5. DELIVERY, STORAGE, AND HANDLING

A. Deliver wires and cables according to NEMA WC 26, Binational Wire and Cable Packaging Standard.

B. Storage: Store wire and cable in a clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.

C. Handling: Handle wire and cable carefully to avoid abrading, puncturing and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

1.6. COORDINATION

A. Coordinate layout and installation of cables with other installations.

B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by Engineer.

C. Determine required separation between cables and other work.

D. Determine cable routing to avoid interference with other work.

1.7. PROJECT CONDITIONS

A. Verify that field measurements are as shown on the Drawings.

B. Feeder conductor sizes are based on copper as indicated on the "Feeder Schedule" on the Contract Drawings.

C. Branch circuit conductor sizes are based on copper.

D. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.

E. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

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:

1. Wires and Cables:

   a. American Insulated Wire Corp.
   b. BICC Brand Rex Company.
   c. General Cable.
   d. Senator Wire & Cable Company.
   e. Southwire Company.
   f. Colonial Wire Company.

2. Connectors and Accessories for Wires and Cables:

   a. 3M Company; Electrical Products Division.
   b. AMP Incorporated.
   c. Buchanan.
   d. General Signal; O Z/Gedney Unit.
   e. Greaves Corporation.
   f. Ideal Industries.
   g. Monogram Company; AFC.
   h. NSI Industries, Inc.
   i. Square D Company; Anderson.

2.2. BUILDING WIRES AND CABLES

A. UL-listed building wires and cables with conductor material, insulation type, cable construction and rating as specified herein.

B. Building wires and cables shall be annealed (soft) copper, 600 volt, Type THHN/THWN (dual-rated) single conductors rated 90°C dry / 75°C wet, with a minimum conductivity of

98 percent at 20°C (68°F), or a maximum resistivity of 1.7 micro-ohms per centimeter.

C. Conductors shall meet or exceed requirements of all applicable ASTM specifications, UL Standard 83, UL Standard 1581, NEMA WC 70, Federal Specification A-A-59544 and shall be RoHS/REACH Compliant.

D. Conductors shall be solid for 10 AWG and smaller, and stranded for 8 AWG and larger.

E. Conductors for VFD output circuits (load side and VFD's). Shall be extra-flexible stranded copper, type XHHW-Z insulation.

F. Building wire and cables shall be color-coded using colors factory impregnated throughout the insulation and jacket. The following color code convention(s) shall be used except where existing systems have established another color code convention:

1. 120/208-Volt, 3-Phase, 4-Wire System:

a.	Phase A:	Black
b.	Phase B:	Red
c.	Phase C:	Blue
d.	Neutral:	White
e.	Ground:	Green

2.3. CONNECTORS AND SPLICES

A. UL listed, factory fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3 Article, "Wire and Insulation Applications".

B. Split Bolt Connectors: Not acceptable.

C. Solderless Pressure Connectors: High copper alloy terminal. May be used only for cable termination to equipment pads or terminals. Not approved for splicing.

D. Spring Wire Connectors: Not acceptable.

E. Mechanical Connectors: Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled cable entrances.

F. Compression (crimp) Connectors: Long barrel; seamless, tin-plated electrolytic high conductivity copper tubing, internally beveled barrel ends. Connector shall be clearly marked with the wire size and type and proper number and location of crimps.

G. Heat shrinkable tubing shall meet the requirements of ANSI C119.1-1986 for buried connections to 90 degrees C and shall be material flame-retarded per IEEE 383 Vertical Tray Flame Test.

H. Motor connection kits shall consist of heat-shrinkable, polymeric insulating material over the connection area and a high dielectric strength mastic to seal the ends against ingress of moisture and contamination. Motor connection kits shall accommodate a range of cable sizes for both in-line and stub-type configurations. Connection kits shall be independent

of cable manufacturer's tolerances.

I. Wire Nut Connectors:

1. Description: Twist-on wire connectors for branch circuit conductors 10 AWG and smaller with a color-coded housing.

2. Construction: Flame-retardant polypropylene housing, rated for 105 degrees Celsius. Zinc-plated steel insert. Square-wire spring to maintain secure positive grip that will not relax over time, no pre-twisting required.

3. Dimensions: Connectors shall be appropriately sized according to manufacturer's recommendation for the suitable wire sizes and voltage rating (600 volts minimum).

4. Quality Assurance:

   a. UL Listed to 486C and 94V-2 Flame Rating.
   b. CSA Certified to C22.2 No. 188
   c. RoHS Compliant

5. Special Features:

   a. Wire connectors for making grounding connections shall have green-colored housing and shall have opening at end of connector for grounding conductor to pass through for connection to metallic outlet boxes.
   b. Wire connectors for all exterior and underground work and work in damp/wet interior locations shall be pre-filled with silicone-based sealant to protect against moisture and corrosion, and shall be UL Listed to 486D for use in damp/wet locations, including direct burial applications.

6. Basis of Design: Provide products by Ideal Industries, Inc. or approved equal.

J. Insulated Connectors (for Conductors 8 AWG and Larger in Dry Locations)

1. Description: Multi-conductor connectors for low voltage (600V or less) circuits, insulated with high-dielectric strength plastisol, molded for precise fit and supplied with removable access plugs over the hex screws.

2. Construction: Range-taking mechanical connector made of aluminum accepts both aluminum and copper conductors. Molded cover of UV stable, impact resistant polypropylene provides rugged protection. Mounting holes at each end of the connector for direct isolated mounting to wiring trough, panelboard, or wireway.

3. Dimensions: Splices and connectors shall be appropriately sized according to manufacturer's recommendation for the suitable wire sizes, quantities, and voltage rating.

4. Quality Assurance: UL listed. UV resistant.

5. Special Features: Connectors shall be rated for temperatures from -45 degrees

Celsius to 90 degrees Celsius.

6. Basis of Design: IPLM/IPLMD Series as manufactured by Polaris, or approved equal.

K. Gel Filled Insulated Connectors (for Conductors 8 AWG and Larger in Damp/Wet Locations)

1. Description: Multi-conductor connectors for low voltage (1,000V or less) circuits, insulated with high-dielectric strength plastisol, molded for precise fit and supplied with removable access plugs over the hex screws. Gel-filled for damp/wet or submersed locations to protect connections from moisture ingress and corrosion.

2. Construction: Range-taking mechanical connector made of tin-plated aluminum accepts both aluminum and copper conductors. Molded cover of UV stable, impact resistant polypropylene provides rugged protection. Cable entry ports and hinged screw port caps shall be sealed with hydrophobic dielectric gel insulation.

3. Dimensions: Splices and connectors shall be appropriately sized according to manufacturer's recommendation for the suitable wire sizes, quantities, and voltage rating.

4. Quality Assurance: ANSI C119.1 for complete unit, ANSI C119.4 for connector, ASTM D543 for chemical resistance, ASTM G-53-95 and ASTM D-638-95 for UV resistance.

5. Special Features: Silicone gel shall be easily removed from conductor for re-entry. Connectors shall be rated for temperatures from -40 degrees Celsius to 95 degrees Celsius.

6. Basis of Design: GPRT Series as manufactured by Raychem/Tyco, or approved equal.

2.4. INSULATING TAPE, PUTTY, RESIN AND SUPPORTS

A. Tape: Provide plastic electrical insulating tape which is flame-retardant, cold and weather-resistant. Tape for use in areas subject to temperatures 30 degrees C to 105 degrees C, or where the tape will be subjected to an oil splash, tape shall have a minimum thickness of 8.5 mils, and shall consist of an oil-resistant acrylic adhesive.

B. Materials: Provide all insulating materials for splices and connections such as glass and synthetic tapes, putties, resins, splice cases, or compositions of the type approved for the particular use, location, voltage and temperature and apply and install in an approved manner, all in accordance with the manufacturer's recommendations.

C. Supports: Provide cable supports of the wedge type which firmly clamp each individual cable and tighten due to the cable weight.

PART 3. EXECUTION

3.1. EXAMINATION

A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. By beginning work, the Contractor has accepted conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.2. PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.3. WIRE AND INSULATION APPLICATIONS

A. No branch circuit wires smaller than 12 AWG shall be used unless otherwise indicated. Conductors shall be continuous from outlet to outlet and from terminal board to point of final connection, and no splice shall be made except within outlet or junction boxes. All conductors shall be of the size indicated. All wires 8 AWG and larger shall be stranded.

B. Control wiring shall not be less than 14 AWG and shall be color coded using colors impregnated into the insulation. All control wiring shall be color coded with wires of colors different from those used to designate phase wires.

C. All wiring, contacts, and terminal blocks shall be suitably tagged for ease in identification and tracing of circuits. Identification tags shall be engraved fiber or plastic type, subject to acceptance. Wires shall be numbered and coded, using Brady Quicklabels, or equal.

D. Wiring shall be tagged at terminations, in pull boxes, junction boxes, outlet boxes, panelboards, etc.…

E. Switch leg wire shall be labeled with “S” tag.

F. Wiring for general 15 and 20 amp branch circuit work shall be as follows unless otherwise indicated:

HOME RUN LENGTH AND WIRE SIZE		CIRCUIT LENGTH AND WIRE SIZE	
120 Volt		120 Volt	
0 – 60 '	12AWG	0-100 '	12AWG
60 – 100 '	10AWG	100’ & Up	10AWG
100' & Up	8AWG		

G. Circuit length as given above shall be the wire length between the first and last outlet on the circuit. Home run length as given above shall be the wire length between the first outlet and the panelboard. In accordance with the above, where the size of branch circuit conductors is increased by the minimum required by the NEC for the branch circuit rating, ensure that the termination provisions of all equipment connected to such circuits are listed as suitable for the conductor sizes involved.

H. Joints of 10 AWG and smaller shall be made with properly insulated solderless type

pressure connectors. Where stranded conductors or multiple solid conductors are connected to terminals, solderless lugs manufactured by Thomas and Betts Company or equivalent shall be used.

I. Joints of 8 AWG and larger shall be of the type indented into the conductor by means of a hand or hydraulic pressure tool. Connectors shall be Burndy Hy dent, T&B Sta Kon, or equivalent. Connectors for control wiring shall be Burndy Hy Lug, or equivalent.

J. All circuits for underground exterior electric work shall be 10 AWG (minimum) and contain a 10 AWG (minimum) copper grounding conductor. All exterior wiring shall be installed in conduit as specified above, unless otherwise noted on the Drawings.

3.4. INSTALLATION

A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's Standard of Installation.

B. Remove existing wires from raceway before pulling in new wires and cables.

C. Pull Conductors: Use a UL-listed and 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.

D. Use pulling means including fish tape, cable, rope, and basket weave wire/cable grips that will not damage cables or raceway. Completely and thoroughly swab conduit system before installing conductors.

E. Install exposed cables, parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Division 26 Section 26 05 00 “Common Work Results for Electrical” and Division 26 Section 26 05 29 “Hangers and Supports for Electrical Systems”.

G. Seal around cables penetrating fire rated elements according to Division 07 Section 07 84 13 “Penetration Firestopping”.

H. Identify wires and cables according to Division 26 Section 26 05 53 “Identification for Electrical System”.

I. Conductors installed in parallel shall be of equal lengths.

J. Wiring at Outlets: Install with at least 6 inches (150 mm) of slack conductor at each outlet in accordance with Article 300.14 of the National Electrical Code.

K. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

L. The Contractor shall provide suitable installation equipment to prevent cutting and abrasion of conductor insulation. The Contractor shall use suitable cable guides, pulleys, and protective sleeving to prevent damage to cable during installation. Ropes used for pulling of wire and cable shall be made of polyethylene or other suitable non-metallic material. Pulling lines shall be attached to cable by means of either woven basket grips or pulling types attached directly to the conductors. Wire pulling lubricants, if used, shall conform to UL requirements applicable to the various insulations and raceway materials. The lubricants shall be certified by the manufacturer to be non-injurious to such insulation and materials.

M. Each cable shall be labeled at terminals and at all accessible points in equipment and in pull boxes. Each wire shall be labeled at both ends. Labels shall be self-sticking wire markers.

N. For rubber and plastic-covered wire and cable, pulling compound Ideal Yellow 77 may be used.

O. Terminal lugs for wires 8 AWG and larger shall be T&B 54,000 Series or Burndy HY-Dent, compression type, unless noted otherwise. One-hole lugs for wires 4/0 AWG and smaller. Two-hole lugs for all wires 250 kcmil AWG and larger.

P. Install wires and cables using braided rope larger than the cable being pulled to keep twists to a minimum.

Q. Provide an insulated green equipment grounding conductor (EGC), sized per NEC, for all feeder and branch circuits, shown or not shown.

R. Multi-wire branch circuits shall not be permitted Provide a separate insulated neutral (grounded) conductor for all feeder and branch circuits requiring a neutral connection.

S. Install electrical cables, wires, and connectors as indicated in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices.

T. Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface.

U. Conductors installed in runs within 6 inches of heating pipes or equipment shall be of types required by the NEC and shall be listed for the application.

V. No conductors shall be drawn into conduit until all work, which may cause cable damage, is completed.

W. All wiring over boilers and breechings, and in other high ambient temperature areas, shall be of types required by NEC and shall be listed for the application.

X. During installation, do not deform cable by improper bending, stretching, twisting, kinking, or pinching, nor do any other abusive handling. Any failure to observe these instructions will be detected and corrected during the demonstrations following completion of the installation.

Y. Cable bends will have a radius not less than the value recommended by the cable manufacturer.

Z. All labels shall be of durable material and securely fastened to the cable.

3.5. CONNECTIONS

A. Conductor Splices: Keep to minimum.

B. Install splices and taps that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

C. Use splice and tap connectors compatible with conductor material.

D. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.

E. 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.

F. Wire splices and taps shall be adequate to carry full current rating of wire.

G. Conductors shall be continuous from outlet to outlet, and no splices shall be made except within outlet or junction boxes. Junction boxes may be utilized where required. Wire connectors of insulating material or solderless pressure connections, properly taped, shall be utilized for all splices in wiring.

H. Splices in branch circuits and feeders shall be made where indicated or as required for the installation. All splices shall be accessible and made in enclosure approved for that purpose.

I. For splices in branch circuits provide connectors as follows;

1. Wire Sizes 10 AWG and smaller: Provide wire nut connectors as specified in Part 2 of this Section.

2. Wire Sizes 8 AWG and Larger: Provide insulated connectors as specified in Part 2 of this Section.

J. Thoroughly clean wiring prior to installing lugs or connectors.

3.6. IDENTIFICATION

A. All building wire and cable shall be color-coded to identify the electrical system(s) as specified. Where color-coding is field-applied, the same shall be accomplished with colored electrical tape wrapped concentrically around each conductor in half-lapped turns, for at least the last six (6) inches of the conductor. One turn around the conductor is not acceptable.

B. Identify wire and cable using Thomas and Betts Type WM vinyl markers.

C. Identify each phase and neutral conductor with its circuit number or other designation indicated on the Drawings in all junction, pull, terminal boxes, and cabinets.

D. Provide identification tags on each conductor entering each panelboard, switch, junction box, and pull box to identify conductor.

E. Comply with the requirements of Division 26 Section 26 05 53 “Identification for Electrical Systems”.

F. Feeder Identification: Securely fasten nonferrous identifying tags or pressure-sensitive labels to all cables, feeders, and power circuits in pull boxes, handholes, panelboards, and at termination of cables.

1. Tags or labels shall be stamped or printed to correspond with markings on Contract Drawings or marked so that feeder or cable may be readily identified.

3.7. FIELD QUALITY CONTROL

A. Visual and Mechanical Inspection:

1. Inspect for defects and physical damage, labeling, and compliance with requirements of drawings and schedules.

2. Clean conductors using Manufacturer’s approved methods and materials.

3. Verify that conductors are correct size and are terminated with appropriately sized lugs.

4. Verify that conductors are correct color for phase identification.

5. Verify that conductors are labeled to identify circuit designation.

6. Verify that neutral conductors are only terminated at neutral lugs/bus, and that grounding conductors are only terminated at grounding lugs/bus.

B. Electrical Tests: Upon installation of conductors and before electrical circuitry has been energized, provide the following minimum inspections and tests according to manufacturer's written instructions to ensure conductors are operational within industry and manufacturer's tolerances, are installed according to the Contract Documents, and are suitable for energizing.

1. Inspect accessible components for cleanliness, mechanical and electrical integrity, and damage or deterioration.

2. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A and UL 486B.

3. Verify continuity of each conductor.

4. Insulation Resistance Testing: Perform megohm meter tests of all new feeder

circuits, including each phase, neutral, and grounding conductor, as follows:

a. Minimum Test Voltage: 1000 Vdc.
b. Minimum Insulation Resistance: 1 megohms.
c. Duration of Each Test: 1 minute.
d. Temperature Correction: Correct results for test temperature deviation from 20 degrees C standard.
e. Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest.
f. Prepare reports identifying equipment checked and describing results of tests. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

5. Infrared Scanning: Perform an infrared scan of each splice and termination in conductors 3 AWG and larger, as follows:

a. Remove equipment covers so terminations are accessible to scanner.
b. Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values.
c. Provide calibration record for device.
d. Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest.
e. Prepare reports identifying equipment checked and describing results of tests. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

6. Test Labeling: On satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.

END OF SECTION

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GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
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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.

B. Refer to Division 26 Section 26 05 19 “Low Voltage Electrical Power Conductors and Cables” for conductor and cable requirements.

1.2. SUMMARY

A. This Section includes grounding of electrical systems and equipment and basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other Sections of these Specifications.

B. Bond together system neutrals; service equipment enclosures; exposed non-current carrying metal parts of electrical equipment; metal raceway systems; grounding conductor in raceways; receptacle ground connectors; and plumbing systems.

1.3. DEFINITIONS

A. EGB: Electrical grounding busbar.

B. EGC: Equipment grounding conductor.

C. GEC: Grounding electrode conductor.

D. SSBJ: Supply-side bonding jumper.

1.4. SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product Data for grounding rods, conductors, connectors and connection materials, and grounding fittings. Submit ground system manufacturer's recommended installation procedure for review.

C. Field tests and observation reports indicating and interpreting the test reports for compliance with performance requirements.

1.5. QUALITY ASSURANCE

A. Comply with NFPA 70 - National Electrical Code.

B. Comply with UL 467 - UL Standard for Safety Grounding and Bonding Equipment.

C. Comply with ANSI/IEEE C2 - National Electrical Safety Code.

D. Comply with ANSI/IEEE 32 - Requirements, terms and test procedures for neutral grounding devices.

E. Comply with IEEE Standard 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

F. Comply with ANSI C33.8.

G. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms Listed and Labeled: As defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.

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:

1. Erico Inc.; Electrical Products Group.

2. Harger Lightning and Grounding; Harger, Inc.

3. Heary Brothers Lightning Protection Co.

4. Ideal Industries, Inc.

5. ILSCO.

6. O-Z/Gedney Co.

7. Raco, Inc.

8. Thomas & Betts, Electrical.

2.2. GROUNDING AND BONDING PRODUCTS

A. Governing Requirements: Where types, sizes, ratings, and quantities indicated are in excess of National Electrical Code (NEC) requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

2.3. WIRE AND CABLE GROUNDING CONDUCTORS

A. Comply with Division 26 Section 26 05 19 “Low Voltage Electrical Power Conductors and Cables”. Conform to NEC Table 8, except as otherwise indicated, for conductor properties,

including stranding.

B. Equipment Grounding Conductors: Size as indicated on the Drawings, or as required by National Electrical Code (NEC) Table 250-122, whichever is larger. Insulated with green color insulation.

C. Grounding Electrode Conductors: Size as indicated on the Drawings, in the Specifications, or as required by National Electrical Code (NEC) Table 250-66, whichever is larger. Insulated with green color insulation, unless installed in direct contact with earth, in which case conductors shall be bare.

D. Bare Copper Conductors: Conform to the following:

1. Solid Conductors: ASTM B 3.

2. Assembly of Stranded Conductors: ASTM B 8.

3. Tinned Conductors: ASTM B 33.

2.4. MISCELLANEOUS CONDUCTORS

A. Braided Bonding Jumpers: Copper tape, braided bare copper wire, terminated with copper ferrules.

B. Bonding Straps: Soft copper, 0.05 inch (1 mm) thick and 2 inches (50 mm) wide, unless otherwise indicated.

2.5. CONNECTOR PRODUCTS

A. Mechanical Connectors

1. The mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy material. Bolts, nuts, washers and lockwashers shall be made of silicon bronze and supplied as a part of the connector body and shall be of the two-bolt type.

2. Split bolt connector types are NOT allowed unless indicated on the Drawings.

3. The connectors shall meet or exceed UL 467 and be clearly marked with the catalog number, conductor size and manufacturer.

B. Compression Connectors

1. The compression connectors shall be manufactured from pure wrought copper. The conductivity of this material shall be no less than 99 percent by IACS Standards.

2. The connectors shall meet or exceed the performance requirements of IEEE 837, latest revision.

3. The installation of the connectors shall be made with a compression, tool and die system, as recommended by the manufacturer of the connectors.

4. The connectors shall be clearly marked with the manufacturer, catalog number, conductor size and the required compression tool settings.

5. Each connector shall be factory filled with an oxide-inhibiting compound.

PART 3. EXECUTION

3.1. APPLICATION

A. Equipment Grounding Conductors: Comply with NEC Article 250 for types, sizes, and quantities of equipment grounding conductors, except where specific types, larger sizes, or more conductors than required by NEC are indicated.

1. Install Equipment Grounding Conductor (EGC) with circuit conductors for the items below in addition to those required by Code:

a. Feeder circuits.
b. Receptacle branch circuits.
c. Single-phase motor or appliance branch circuits.
d. Three-phase motor or appliance branch circuits.
e. Flexible raceway runs.
f. Metal-clad (MC) cable runs.

2. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

B. Mechanical System Grounding:

1. All mechanical equipment, including but not limited to pumps, motors, packaged equipment, fans, heaters, etc. and their enclosures shall be properly grounded in accordance with Article 250 of the National Electrical Code.

2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.2. INSTALLATION

A. General: Ground electrical systems and equipment according to NEC requirements, except where Drawings or Specifications exceed NEC requirements.

B. Grounding Bus Bars: Space 1 inch (25 mm) from wall and support from wall 6 inches (150 mm) above finished floor, except as otherwise indicated.

C. Grounding Conductors: Route along the shortest and straightest paths possible, except as otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

D. Grounding shall satisfy requirements of the applicable publications. All exposed noncurrent-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in nonmetallic raceways, and grounded conductors of the wiring system shall be grounded.

E. The grounded conductor (neutral) of the wiring system shall be connected to the system grounding conductor at a single place in the system by removable bonding jumpers, sized according to the applicable provisions of the National Electrical Code. The grounded conductor (neutral) connection to the grounding conductor (ground) shall be located in the enclosure for the system's overcurrent protection or where otherwise indicated on the Drawings or Specifications.

F. Ground buses and neutral buses in all branch panelboards and those provided in any equipment shall be isolated except where required to be connected as specified above for the service entrance and in transformer terminal compartments.

G. Equipment grounding conductors shall be extended from the ground bus in the distribution equipment to the receptacle, fixture or device lugs where they are provided. When not provided, they shall be connected to equipment enclosures. The connections shall be arranged such that removal of receptacle, the equipment grounding conductors, or ground jumpers from ground busing, shall not affect the system ground.

H. Ground bus shall be provided as indicated on the Drawings or as necessary to provide termination for equipment grounding conductor. Non-current carrying metal parts of electric equipment shall be effectively grounded by bonding to the bus.

I. Raceways shall not be considered as a grounding conductor. Each power, lighting, or control raceway shall have a separate equipment grounding conductor installed. Receptacles shall have a separate grounding pole.

3.3. CONNECTIONS

A. General: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to assure high conductivity and to make contact points closer in order of galvanic series.

2. Make connections with clean, bare metal at points of contact.

3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.

4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.

5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Equipment Grounding Conductor (EGC) Terminations: For 8 AWG and larger, use compression-type grounding lugs. 10 AWG and smaller grounding conductors may be terminated with wire nut connectors as specified in Division 26 Section 26 05 19 “Low Voltage Electrical Power Conductors and Cables”.

C. Non-Contact Metal Raceway Terminations: Where metallic raceways terminate at metal

housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors, except as otherwise indicated.

D. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. Where these requirements are not available, use those specified in UL 486A and UL 486B.

E. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
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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.

B. Requirements of the following Sections apply to this Section:

1. Division 26 Section 26 05 00 “Common Work Results for Electrical” for general installation requirements.

1.2. SUMMARY

A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

B. Provide equipment supports consisting of structural members, hangers, rods, racks, and incidental materials.

C. Provide all labor, supervision, and fabrication. Design and construct supporting structures of strength to safely withstand stresses to which they may be subjected and to properly distribute the load and impact over building areas. Provide all engineering and fabrication as required for installation of support system.

D. Provide hangers, clamps, anchors, inserts, supports, supplementary steel framing, and hardware of the proper size and load capacity to support electrical equipment and raceways, whether indicated on the drawings or not.

1.3. SUBMITTALS

A. General: Submit the following in accordance with conditions of Contract and Division 01 Specification Sections.

B. Product data for each type of product specified.

1.4. QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with NFPA 70 National Electrical Code.

B. Electrical components shall be listed and labeled by UL, ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party Certification follow-up services.

C. Installation Standard: Installation shall meet or exceed the National Electrical Contractors Association (NECA) Standard of Installation.

D. Manufacturer's Qualifications:

1. The Manufacturer shall not have had less than ten years' experience in manufacturing Strut Support Systems.

2. The Manufacturer must certify in writing all components supplied have been produced in accordance with an established quality assurance program.

E. All Strut Support System components must be supplied by a single manufacturer.

F. Standards:

1. Work shall meet the requirements of the following standards:

a. Federal, State and Local Codes.
b. American Iron and Steel Institute (AISI) Specification for the Design of Cold-Formed Steel Structural Members.
c. American Society for Testing and Materials (ASTM).
d. Underwriters Laboratories (UL).
e. National Electrical Code (NEC).

1.5. PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All material is to be delivered to the work site in original factory packaging to avoid damage to the finish.

B. Upon delivery to the work site, all components shall be protected from the elements by a shelter or other covering.

1.6. GUARANTEE

A. Separate guarantees shall be issued from the erector and manufacturer, valid for a period of one year against any defects that may arise from the installation or manufacture of the Strut Support System components.

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. Slotted Metal Angle and U-Channel Systems:

a. American Electric, Kindorf
b. Alstrut
c. Unistrut Diversified Products
d. Power-Strut
e. Thomas & Betts

2.2. COATINGS

A. Dry, Interior Locations: Supports, support hardware, and fasteners shall be protected with

zinc coating or with treatment of equivalent corrosion-resistance using approved alternative treatment, finish, or inherent material characteristic. All products installed in dry interior locations shall be hot-dip galvanized, unless otherwise noted.

B. Damp or Wet Locations: Supports, support hardware, and fasteners installed in damp or wet locations, including exterior locations, shall be Type 304 stainless steel.

2.3. MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

B. Fasteners: Types, materials, and construction features, as follows:

1. Expansion Anchors - Carbon steel wedge or sleeve type.

2. Toggle Bolts - All steel springhead type.

3. Power-Driven Threaded Studs - Heat-treated steel, designed specifically for the intended application.

C. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.

D. U-Channel Systems: Sixteen-gauge channels with 9/16-inch-diameter slotted holes at a minimum of two inches on center in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacturer.

E. Floor-Mounted Stands: Construct with structural steel members or steel pipe and fasten with flanges bolted to the floor.

F. Wall-Mounted Platforms: Construct with steel brackets.

2.4. ANCHOR METHODS

A. Hollow Masonry: Toggle bolts or plastic conical type expansion anchors.

B. Solid Masonry: Lead expansion anchors or preset inserts.

C. Metal Surfaces: Machine screws, bolts, or welded studs.

D. Wood Surfaces: Wood screws.

E. Concrete Surfaces: Self-drilling anchors or power-driven studs (non-seismic zones).

PART 3. EXECUTION

3.1. EXAMINATION

A. The installer shall inspect the work area prior to installation. If work area conditions are

unsatisfactory, installation shall not proceed until satisfactory corrections are completed.

3.2. INSTALLATION

A. Set Strut System components into final position true to line, level and plumb, in accordance with approved Shop Drawings.

B. Anchor material firmly in place. Tighten all connections to their recommended torques.

C. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

D. Coordinate with the building structural system and with other electrical installation.

E. Raceway Supports: Comply with the NEC and the following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.

2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 pounds, provide additional strength until there is a minimum of 200 pounds safety allowance in the strength of each support.

3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

4. Support parallel runs of horizontal raceways together on trapeze-type hangers.

5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.

6. Space supports for raceways in accordance with Table I of this Section. Space supports for raceway types not covered by the above in accordance with NEC.

7. Support exposed and concealed raceway within one foot of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminations are not made with chase nipples or threadless box connectors.

8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminations.

F. Miscellaneous Supports: Support miscellaneous electrical components as required to

produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting disconnects, light fixtures, and other devices.

G. In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to the raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.

H. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including, but not limited to conduits, raceways, boxes, disconnect switches, and control components in accordance with the following:

1. Fasten by means of toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures.

2. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4-inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.

3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration-and shock-resistant fasteners for attachments to concrete slabs.

I. General Supporting Installations:

1. Provide appropriate concrete anchors for hanger rods. Rods shall be screwed into or extended through frame construction (with washer and nut). Supports shall secure conduit in place, and shall prevent vibration, provide for expansion and contraction and shall make neat appearance. Strap hangers or chains are not permitted.

2. Electrical raceways 1-1/2-inches and smaller shall be secured with 1-hole malleable iron straps or brackets to walls. Trapeze supports shall be used for groups or parallel raceways with raceways secured to trapeze with approved clamps. Individual runs of raceways 2-inches and larger shall be supported by Clevis type hangers.

3. Provide all steel supports including roof curbs for all equipment provided under this Section.

4. Electrical raceway supports to be spaced on the following maximum centers, unless otherwise required by the NEC:

a. 3/4-inch to 1-inch conduit - 8 feet
b. 1-1/4-inch and larger conduit - 10 feet

J. Provide additional hangers or steel members to distribute the load among two or more structural members when required or directed.

K. Locations:

1. Anchor bolts, sleeves, inserts, hangers, and supports required for the electrical work shall be furnished and installed under Division 26.

2. Coordinate with other trades the location of anchors, sleeves, inserts, and supports and insure that they are properly installed.

3. Openings and sleeves shall be set true to line, level, plumb, and position and shall be set true to line, level, plumb, and position and shall be so maintained during construction. Where sleeves and openings are provided in poured concrete, inspect same during and after concrete is poured to insure proper position and correct any deviation.

L. Hangers and Supports:

1. Provide hangers, angles, channels, and other supports required by field conditions to install items of electrical equipment. Design of supports and methods of fastening to building structure shall be acceptable to the Owner.

2. Use of power-actuated fasteners and devices is permitted in the vertical surfaces of the building only with the following requirements.

   a. For fastening conduits 1-1/2-inch and smaller and lighting fixtures 50 lbs or less.
   b. Load capacity per manufacturers' recommendations.
   c. Fasteners shall be located in the thickest part of the slab.
   d. Devices shall comply with OSHA requirements.

3. Use of lead shield expansion anchors is not permitted.

4. No electrical items shall rest on, or depend for support on suspended ceiling media (tiles, lath, plaster, splines, etc.).

5. In spaces with suspended ceilings, support conduits directly from structural slabs, decks (or framing members). Do not support conduits on ceiling suspension members.

6. Provide weight-distribution facilities, where required so as not to exceed the load bearing capabilities of floor or walls that bear the weight of, or support, electrical items.

7. For point-of-attachment weight of 100 lbs. or less, fasten items as follows:

   a. On wood, use wood screws.
   b. On concrete and solid masonry that is already in place, use self-drilling concrete anchors or expansion bolt and couplings.
   c. On hollow construction, use toggle bolts.

d. On structural steel, use beam clamps.

8. For point-of-attachment weights from 100 lbs. to 300 lbs., provide supports as follows:

   a. At cast-in-place concrete slabs, use concrete inserts in bottom of slab, with 8" slip-through steel rods set transverse to the reinforcing steel.
   b. At concrete slab already in place, uses 16-inches x 8-inches x ½-inch steel plates at the top of the slab, with through-bolts welded in place. The plates

9. Equipment shall not be held in place by its own dead weight. Provide base anchor fasteners in each case.

10. Trapeze type hangers may be used where several conduits are to be installed at the same elevation. The spacing of such trapeze hangers shall be in accordance with the NEC for the smallest conduit in the run.

11. Vertical conduits shall be supported by heavy wrought iron clamps or collars anchored to construction at each floor.

M. Inserts:

1. Inserts for suspended items in poured concrete construction shall be malleable-iron concrete inserts, adjustable type with insert nut. Items manufactured by Barrett, Crawford, Elcen, or Grinnell shall be used where applicable.

2. Inserts for surface-mounted items shall be suitable for the composition of the slab, wall, or structure on which installation is to be made.

N. TABLE I: SPACING FOR RACEWAY SUPPORTS

TABLE I: SPACING FOR RACEWAY SUPPORTS				
Raceway Size (Inches)	No. of Conductors in Run	Location	PVC & RGS (Ft.)	EMT (Ft.)
		HORIZONTAL RUNS		
1/2, 3/4	1 or 2	Flat ceiling or wall.	5	5
1/2, 3/4	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	7	7
1/2, 3/4	3 or more	Any location.	7	7
1/2 - 1	3 or more	Any location.		
1 & larger	1 or 2	Flat ceiling or wall.	6	6
1 & larger	1 or more	Where it is difficult to provide supports except at intervals fixed by the building construction.	10	10
1 & larger	3 or more	Any location.	10	10
Any	---	Concealed.	10	10
		VERTICAL RUNS		
1/2, 3/4	---	Exposed.	7	7
1, 1-1/4	---	Exposed.	8	8
1-1/2 & larger	---	Exposed.	10	10
Up to 2	---	Shaftway.	14	10

2-1/2	---	Shaftway.	16	10
3 & larger	---	Shaftway.	20	10
Any	---	Concealed.	10	10
Abbreviations:	EMT	Electrical Metallic Tubing		
	PVC	Rigid Polyvinyl Chloride Conduit		
	RGS	Rigid Galvanized Steel Conduit		

3.3. CLEANUP

A. Upon completion of this Section of work, remove all protective wraps and debris. Repair any damage due to installation of this section of work.

3.4. PROTECTION

A. During installation, protect this work from damage.

B. Upon completion of this scope of work, it shall become the responsibility of the General Contractor to protect this work from damage during the remainder of construction on the project and until substantial completion.

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SECTION 26 05 33
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
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SECTION 26 05 33
RACEWAYS 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.

B. Related Sections include the following:

1. Division 26 Section 26 05 19 “Low Voltage Electrical Power Conductors and Cables” for conductors installed in raceways and boxes and conductor terminations.

2. Division 07 Section 07 84 13 “Penetration Firestopping” for requirements for firestopping at penetrations through walls and floors that are fire barriers.

3. Division 26 Section 26 05 29 “Hangers and Supports for Electrical Systems” for raceways and box supports.

4. Division 26 Section 26 05 34 “Surface Metal Raceway” for surface raceways, fittings, and accessories.

5. Division 26 Section 26 27 26 “Wiring Devices” for devices installed in boxes.

1.2. SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1. Raceways include the following:

a. EMT
b. FMC
c. LFMC
d. RGS
e. Wireways

2. Boxes, enclosures, and cabinets include the following:

a. Device boxes
b. Outlet boxes
c. Pull and junction boxes
d. Cabinets and hinged cover enclosures

3. Miscellaneous Products include the following:

a. Bushings

1.3. DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FMC: Flexible Metal Conduit.

C. LFMC: Liquidtight Flexible Metal Conduit.

D. RGS: Rigid Galvanized Steel Conduit.

1.4. SUBMITTALS

A. Product Data: For raceways, boxes, wireways and fittings, hinged cover enclosures, and cabinets.

B. Shop Drawings: Include layout drawings showing components and wiring for nonstandard boxes, enclosures, and cabinets.

1.5. QUALITY ASSURANCE

A. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

B. Comply with NECA's "Standard of Installation" and NECA 101 “Recommended Practice for Installing Steel Conduits”.

C. Comply with NFPA 70.

1.6. COORDINATION

A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

B. Verify routing and termination locations of conduits and boxes prior to rough-in.

C. Conduit routing shown on Drawings is only approximate and diagrammatic. Route conduits as required for a complete conduit and wiring system.

D. Coordinate final locations, mounting heights, and orientation of all outlet, junction, and pull boxes.

1.7. PROJECT RECORD DOCUMENTS:

A. Accurately record routing of all concealed conduits. Record actual routing of all exposed conduits/larger than 1 inch. Indicate actual locations and mounting heights of outlet boxes, pull and junction boxes, branch circuits, arrangements, etc.

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:

1. Metal Conduit and Tubing:

   a. Allied Tube & Conduit Corporation.
   b. Anamet, Inc.; Anaconda Metal Hose.
   c. AFC/Monogram Company.
   d. Carol Cable Co., Inc.
   e. Cole Flex Corp.
   f. Electri Flex Co.
   g. Flexcon, Inc.; Coleman Cable Systems, Inc.
   h. Grinnell Co.; Allied Tube and Conduit Div.
   i. Monogram Co.; AFC.
   j. Spiraduct, Inc.
   k. Triangle PWC, Inc.
   l. Wheatland Tube Corporation

2. Conduit Bodies and Fittings:

   a. American Electric; Construction Materials Group.
   b. Crouse Hinds; Div. of Cooper Industries.
   c. Emerson Electric Co.; Appleton Electric Co.
   d. Hubbell, Inc.; Killark Electric Manufacturing Co.
   e. Lamson & Sessions; Carlon Electrical Products.
   f. Z/Gedney; Unit of General Signal.
   g. Scott Fetzer Co.; Adalet PLM.
   h. Spring City Electrical Manufacturing Co.
   i. Thomas & Betts Corporation.

3. Metal Wireways:

   a. Hoffman Engineering Co.
   b. Keystone/Rees, Inc.
   c. Square D Co.

4. Boxes, Enclosures, and Cabinets:

   a. American Electric; FL Industries.
   b. Butler Manufacturing Co.; Walker Division.
   c. Crouse Hinds; Div. of Cooper Industries.
   d. Electric Panelboard Co., Inc.
   e. Erickson Electrical Equipment Co.
   f. Hoffman Engineering Co.; Federal Hoffman, Inc.
   g. Hubbell Inc.; Killark Electric Manufacturing Co.
   h. Hubbell Inc.; Raco, Inc.
   i. Lamson & Sessions; Carlon Electrical Products.
   j. Z/Gedney; Unit of General Signal.

k. Parker Electrical Manufacturing Co.
l. Robroy Industries, Inc.; Electrical Division.
m. Scott Fetzer Co.; Adalet PLM.
n. Spring City Electrical Manufacturing Co.
o. Thomas & Betts Corp.
p. Woodhead Industries, Inc.; Daniel Woodhead Co.

2.2. METAL CONDUIT AND TUBING

A. EMT and Fittings: Hot galvanized steel O.D. with an organic corrosion-resistant I.D. coating. Listed to UL Safety Standard 797 and manufactured in accordance with ANSI C80.3.

1. Fittings: Compression type, NEMA FB1.

B. FMC: Zinc coated steel.

C. LFMC: Flexible steel conduit with PVC jacket.

D. RGS: ANSI C80.1 and UL 6.

E. Fittings: NEMA FB 1; compatible with conduit/tubing materials.

2.3. NONMETALLIC CONDUIT AND TUBING

A. PVC: NEMA TC 2, UL 651, Schedule 40 or 80.

B. PVC Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.

2.4. METAL WIREWAYS

A. Material: Sheet metal sized and shaped as indicated.

B. 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.

C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

D. Wireway Covers: Screw cover type.

E. Finish:

1. Dry Interior Locations: Manufacturer's standard enamel or galvanized finish, NEMA 1.

2. Damp/Wet Locations: Stainless steel, NEMA 4X.

2.5. OUTLET AND DEVICE BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized flat-rolled sheet steel.

B. Cast Metal Boxes: NEMA FB 1, Type FD, cast box, deep type, with gasketed cover, and threaded hubs.

C. Outlet Box Accessories: Provide outlet box accessories as required for each installation, including corrosion-resistant screws, mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps, and metal straps for supporting outlet boxes which are compatible with outlet boxes being used and fulfilling requirements of individual wiring situations.

D. Nonmetallic: NEMA OS2.

2.6. PULL AND JUNCTION BOXES

A. Small Sheet Metal Boxes: NEMA OS 1, galvanized flat-rolled sheet steel.

B. Sheet metal boxes over 12" in any dimension shall comply with the requirements of Article "Enclosures and Cabinets" of this Section.

C. Boxes for Outdoor and Wet Locations: Flat flanged, surface-mounted, UL listed as raintight, galvanized cast iron box and cover with neoprene gasket and stainless steel cover screws.

2.7. BOX EXTENSIONS

A. Where more than one box is needed to flush out installation, provide a large (i.e., 6" x 6") box to flush out the existing box and nipple over to a new box.

2.8. BUSHINGS

A. Bushings shall be self-extinguishing thermoplastic type with 105 degrees C (minimum) temperature rating.

B. Bushings with grounding lugs shall be malleable iron body with 105 degrees C (minimum) insulating ring. Insulating material shall be locked in place and non-removable.

2.9. ENCLOSURES AND CABINETS

A. Hinged Cover Enclosures: NEMA 250, Type 1 in dry locations, and Type 4 in wet or damp locations, with continuous hinge cover and flush latch.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

B. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

PART 3. EXECUTION

3.1. EXAMINATION

A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2. RACEWAY AND BOX REQUIREMENTS

A. Conduit Application Schedule:

APPLICATION	CONDUIT TYPE	REMARKS
Exposed exterior locations.	RGS	Use threaded or rain-tight fittings and stainless steel hardware.
Damp/Wet interior locations.	RGS	Use threaded or rain-tight fittings and stainless steel hardware.
Exposed dry interior locations.	EMT, RGS	Schedule 40 PVC is acceptable for concealing grounding electrode conductors, except for plenum spaces. Provide RGS conduit where subject to physical damage.
Exterior underground.	RNC (Sched. 40 PVC)	RGS Elbows/Sweeps unless otherwise noted on the Drawings.
Equipment connections in dry interior locations.	FMC (e.g. Greenfield)	Short lengths only (maximum 6 feet).
Equipment connections in wet interior locations.	LFMC (e.g. Sealtite)	Short lengths only (maximum 6 feet). Use threaded or rain-tight fittings and stainless steel hardware.
Equipment connections in exterior locations.	LFMC (e.g Sealtite)	Short lengths only (maximum 6 feet). Use threaded or rain-tight fittings and stainless steel hardware.
Concealed in dry wall construction.	EMT	
Concealed above suspended ceilings.	EMT	
Concealed in masonry walls.	EMT	

B. General Requirements

1. Provide hot-dip Rigid Galvanized Steel Conduit (RGS) for exposed work in locations subject to physical damage, and for work in damp/wet locations,.

2. Aluminum conduit is prohibited.

3. Conduits for exterior underground electric work shall be rigid steel, galvanized and sherardized, leaving the building and to points 5 feet beyond footings. Beyond 5 feet of building, underground conduits shall be non-metallic Schedule 40 PVC, Type II.

4. Conduits shall slope from entrance equipment toward outside of building.

C. Fittings:

1. All fittings to match conduit material and to be suitable for the purpose intended. Join conduit with fittings designed and approved for the purpose and make joints tight.

2. Provide UL listed compound filled sealing fittings for NEC-required locations, for conduits passing from interior to exterior, and at the interface of widely different space temperatures such as refrigeration or cold storage rooms where conduits pass from warm locations to cool locations, such as the boundaries of air conditioned spaces and non-conditioned air spaces. For concealed conduits, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.

3. Provide expansion fittings with bonding jumpers where conduits cross expansion joints or where otherwise required to compensate for thermal expansion and contraction. Provide expansion fittings in each straight uninterrupted run of surface-mounted conduit, both horizontal and vertical, in excess of 200 feet. Distance between fittings shall not exceed 200 linear feet. The Contractor shall refer to the Architectural Drawings for expansion joint locations.

4. Fasten rigid steel conduit with threaded galvanized steel fittings, double locknuts, and insulated bushings. Insulated bushings shall be OZ/Gedney type "B", or equal.

5. Fasten EMT conduit with concrete-tight or rain-tight compression fittings made from zinc-plated steel. Fittings using set screw or indentations as a means of attachment or made from cast "white metal" are prohibited. All connectors shall have insulated throats.

6. Fasten liquid-tight conduit with fittings incorporating a threaded ferrule, nylon sealing ring, and steel or malleable iron compression nut and body. Furnish Crouse Hinds metallic liquid-tight fittings, or equal.

7. Fasten Flexible Metallic Conduit (FMC) with Thomas & Betts (T&B) "Tite-Bite" insulated connectors, or equal.

8. Watertight fittings shall use a copper base anti-corrosive conductive compound. Provide watertight fittings for conduits in damp or wet locations, underground locations.

D. Box Locations:

1. Electrical boxes shall accommodate wire pulling, splices, taps, equipment connections and Code compliance.

2. Coordinate access doors as required to provide access to boxes in hard ceilings and similar inaccessible areas.

E. Outlet Boxes:

1. Outlet boxes for dry interior locations and for concealed work shall be zinc-coated or cadmium-plated sheet steel boxes suitable for the service and type outlet.

2. Boxes and conduit fittings for damp or wet locations and exposed locations subject to damage shall be NEMA 4 cast-aluminum, cast steel or cast iron type with gasketed cover plates and threaded hubs for conduit entrance.

3. Extra-large boxes shall be provided in accordance with the National Electrical Code where necessary to prevent crowding of wire in the box.

4. Plastic boxes and cast "white metal" boxes classified as NEMA 4 will not be acceptable.

5. All boxes, whether outlet, junction, pull, or equipment, shall be furnished with appropriate covers.

6. No sectionalized boxes shall be used.

7. Provide factory-made knockout closures for unused openings in outlet boxes.

8. Provide blank coverplates for all unused boxes.

F. Junction and Pull Boxes:

1. Junction and pull boxes shall be furnished and installed as shown or where required to facilitate pulling of wires or cables. Such boxes shall be installed in accessible locations. All boxes for concealed work shall be constructed of 12 gauge USS galvanized sheet steel minimum, unless otherwise specified or indicated and provided with mounting brackets and flat screw covers secured in position by round head brass or stainless steel 300 grade machine screws. Boxes for exterior work shall be cast aluminum or galvanized cast iron type with threaded hubs unless otherwise directed. Gasketed cover plates shall be furnished for outdoor installation.

2. Wherever possible, locate pull and junction boxes above accessible ceilings in finished areas.

3. Pull or junction boxes shall be supported independently of conduit.

3.3. INSTALLATION OF RACEWAYS

A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.

B. Furnish and install a separate and independent raceway system as shown on the Drawings for each of the various wiring systems including, but not limited to, the following:

1. Communications System

2. Control Wiring

3. Power

C. All raceway systems shall be completely wired as specified herein, shown on drawings and/or required for satisfactory operation of the various systems.

D. Raceways, generally, shall be concealed conduit as specified herein. Where wiring troughs are required or used to facilitate the wiring installation, they shall be equal to Square D Company's Square-Duct and fittings, with hinged cover arranged for total removal, all finished in baked enamel and all components U/L listed. The gutters shall be of ample size to accommodate conductors therein and as required by the NEC.

E. Support all conduit not embedded in concrete or masonry such that strain is not transmitted to outlet boxes and pull/junction boxes, etc. Supports to be sufficiently rigid to prevent distortion of conduits during wire pulling.

F. Minimum Raceway Size:

1. 3/4 inch trade size for interior work

2. 1-inch trade size for exterior underground work**.**

G. Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors.

H. Electrical Metallic Tubing (EMT) shall be used for the following unless otherwise indicated:

1. Branch circuits and feeders for lighting, receptacles, and power concealed in:

   a. Dry wall construction.
   b. Hard ceilings, e.g. gypsum, wood, plaster, etc.
   c. Masonry walls.

2. Exposed in equipment room areas as needed to serve fixed equipment.

3. Circuits for communication and signaling concealed in:

   a. Dry wall construction.
   b. Hard ceilings, e.g. gypsum, wood, plaster, etc…

I. Rigid Galvanized Steel Conduit (RGS) shall be used for the following, unless otherwise indicated:

1. Branch circuits and feeders for lighting, receptacle and power, installed exposed in areas subject to physical damage.

2. Circuits for communication and signaling exposed in areas subject to physical damage.

J. Communications, Control**,** and Automatic Temperature Control (ATC), system wiring shall be installed in raceways within partitions, terminated 8” above accessible ceiling with 90 degree bend with insulating bushing on the end. Free-run cabling above accessible ceilings shall be supported by J-hooks and/or bridle rings at required spacing intervals. Cabling above inaccessible ceilings and in exposed locations shall be installed completely in raceway.

K. Wiring installed concealed above hard ceilings and exposed in areas with no ceilings shall

be installed in conduit.

L. Conduit shall be run concealed wherever possible, within walls, ceilings, or floors, unless otherwise indicated or specified. Where exposed conduits runs are shown or required, they shall be run parallel to building construction and shall be suitably supported at required intervals.

M. Conduit may be run exposed in Mechanical Equipment rooms, Electrical rooms, and where necessary in Storage rooms and unfinished areas. Where conduit is run exposed, it shall be run as close as possible to walls and ceilings and shall not interfere with equipment, ductwork and piping.

N. Keep raceways at least 12 inches (300 mm) away from parallel runs of flues, steam or hot water pipes and other hot surfaces above 77 degrees F. Install horizontal raceway runs above water and steam piping.

O. Install raceways level and square and at proper elevations. Provide adequate headroom.

P. Complete raceway installation before starting conductor installation.

Q. Support raceways as specified in Division 26 Section 26 05 29 "Hangers and Supports for Electrical Systems". Arrange supports to prevent misalignment during wiring installation.

R. Use capped bushings or "push-penny" plugs to prevent foreign matter from entering the conduit system during construction. Clean and plug or cap all conduits left empty for future use.

S. Make bends and offsets so the inside diameter is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.

T. Use raceway fittings compatible with raceways and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, unless otherwise indicated.

U. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.

V. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.

W. Run parallel or banked raceways together, on common supports where practical.

X. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

Y. Join raceways with fittings designed and approved for the purpose and make joints tight.

1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.

2. Use insulating bushings to protect conductors.

Z. Tighten set screws of threadless fittings with suitable tools.

AA. Install pull wires in empty raceways. Use 14 AWG zinc coated steel or monofilament plastic line with not less than 200 lb (90 kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of the pull wire.

BB. Lubricants for pulling wires shall be approved for use with the types of wire and conduit installed.

CC. All metal raceways for circuits over 250-volts to ground shall be bonded per NEC Article 250.97.

DD. Install no more than equivalent of three 90° bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2 inches (50 mm) in size.

EE. Avoid moisture traps; provide junction box with drain fittings at low points in conduit system.

FF. Die-cast fittings of pot metal will not be accepted.

GG. Conduits shall be free of any burrs, foreign objects, and water prior to conduit installation.

HH. Conduit placed against concrete or masonry above ground shall be fastened to the concrete or masonry with pipe straps or one screw clamp attached to the concrete by means of expansion screw anchors and screws. "Caddy Clip" type hangers or straps will be permitted only in non-exposed areas and restricted to 3/4" conduit.

II. Rigid conduit or Electrical Metallic Tubing (EMT) shall not be strapped or fastened to equipment subject to vibration or mounted on shock-absorbing bases.

JJ. Conduit shall be installed in such manner as to ensure against the collection of trapped condensation, and runs of conduit shall be without traps wherever possible. Drill 1/8" diameter weep holes where necessary.

KK. Conduits run to and from cabinets shall be run neatly, in accurate manner and shall emerge from the floors and ceilings at right angles thereto.

LL. Exposed conduit installed on or adjacent to ventilating ducts shall be installed after the ducts are in place, and shall be run from ceiling or wall junction boxes in such manner as to retain accessibility to junction box covers and to permit future removal or replacement of ducts.

MM. Conduits and other electrical items shall not be fastened to, or supported from ventilating ducts but shall be separately supported. The method of supporting and details of the supporting members shall be reviewed by the Owner's Representative. In no case shall screws penetrate the sheet metal of the ducts.

NN. Exposed conduit run on surface shall be supported according to Code and within three feet of each outlet, junction box, or cabinet, by galvanized malleable conduit clamps and clamp backs. Suspended conduits shall be supported every five feet by conduit hangers and round

rods, or where two or more conduits are run parallel, by trapeze hangers suitably braced to prevent swaying.

OO. Screws and other hardware for all work in damp/wet locations shall be stainless steel, unless otherwise noted.

PP. Zinc coated galvanized steel screws may be used for interior dry locations only.

QQ. No running threads shall be cut or used.

RR. Conduits which are installed at this time and left empty for future use and which are five feet or more in length shall have a non-ferrous, 600 lb. tensile strength drag line left in place for future use.

3.4. INSTALLATION OF BOXES

A. Provide grounding connections for raceway, boxes, and components as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors.

B. Provide junction boxes, pull boxes, cable support boxes, and wireways as required for proper installation of the electrical work. Covers shall be accessible. Small junction boxes shall be similar to outlet boxes.

C. Pull boxes, cable support boxes, and large junction boxes for indoor use shall be made of Code gauge steel or no less than 12 gauge. Covers shall be held in place with zinc-coated galvanized steel screws. Paint interior and exterior surfaces with rust-inhibitive paint. (Pull boxes and covers shall be hot-dipped galvanized.)

D. Boxes located outdoors and in damp or wet locations shall be cast metal or alloy, fitted with screw-fastened covers and gaskets, and with threaded conduit connections. Fasteners shall be stainless steel.

E. Pull boxes shall be installed at all necessary points to facilitate pulling of wires and to prevent injury to the insulation or other damage that might result from pulling resistance or for other reasons necessary for proper installation. Pull box locations shall be approved by the Owner's representative prior to installation.

F. Where boxes are used in connection with exposed conduit, plain covers attached to the box with a suitable number of countersunk flat head machine screws shall be used.

G. Pull boxes with barriers shall have a single cover plate and the barriers shall be of the same gauge as the pull box.

H. Exposed pull boxes will not be permitted in finished spaces.

I. Location of pull boxes shall be coordinated with piping, ductwork, and other equipment so as to permit sufficient clearance for maintenance and access.

J. Pull boxes recessed in walls or partitions shall be provided with flanged type covers.

K. Outlet boxes and covers shall be of proper Code size for the number of wires and/or conduits passing through or terminating therein, but in no case shall any box be less than 4" square.

L. Outlet boxes for switches shall be of the gang type.

M. Each circuit in each pullbox shall be marked with a tag guide denoting panels to which they connect.

N. Boxes shall be separated to prevent sound transmission. Back-to-back boxes shall not be used.

O. Outlet boxes shall be provided with suitable plaster rings and covers or plates.

P. Unused knockout holes shall remain closed and those opened by error shall be closed with approved factory-made knock-out seals.

Q. Outlet boxes installed in plenum ceilings shall be in accordance with applicable codes.

R. Outlet boxes shall be installed true and plumb so that the covers or plates will be level and at uniform elevations for the types of outlets contained.

S. Outlet boxes for toggle switches at doorways shall be located at the strike side of the door as finally hung.

T. Outlet box locations as indicated shall be considered to be approximate only. Determine exact locations from architectural details or from field instructions and coordinate outlet box locations with the work of other trades.

U. Install junction and pull boxes to be accessible.

V. Locations of junction and pull boxes requiring access panels shall be reviewed by the Owner's Representative.

W. Install hinged-cover enclosures and cabinets plumb. Support at each corner at minimum.

3.5. INSTALLATION OF TERMINATIONS

A. Where raceways are terminated with lock nuts and bushings, align the raceway to enter squarely, and install the lock nuts with dished part against the box. Where terminations cannot be made secure with one lock nut, use two lock nuts, one inside and one outside of the box.

B. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

C. Open ends shall be capped with approved manufactured conduit seals as soon as installed and kept capped until ready to pull in conductors.

D. Where conductors enter a raceway, cabinet, pull box, and junction box, the conductors shall

be protected by an insulated bushing providing a smoothly rounded surface.

E. Water tight hubs shall be used at termination of rigid conduit in knock-out openings.

F. Ends of conduits shall be equipped with insulating bushings for 1" and smaller, and insulated metallic bushings for 1-1/4" and larger. Ends of conduit shall be temporarily capped prior to installation and during construction to exclude foreign material.

3.6. FLEXIBLE CONNECTIONS

A. Provide Liquidtight Flexible Metal Conduit (LFMC), e.g. Sealtite, in short lengths (maximum 6 feet) for the final connection of exterior equipment, motors and equipment in damp or wet locations as defined in Division 26 Section 26 05 00 “Common Work Results for Electrical”.

B. Grounding conductors with green colored insulation shall be extended through all flexible connections including fixture "whips", and fastened to terminals within the first junction boxes on either side of the flexible length.

C. Flexible connections shall be sized per the Contract Drawings, or as required in accordance with Code; the more stringent requirement shall apply.

3.7. PAINTING AND FINISHES

A. All exterior equipment and conduits shall be painted to match adjacent surface in color as selected by Owner, unless otherwise indicated by the Owner.

B. All exposed conduit, boxes, equipment, etc. in finished spaces shall be painted. Colors shall be as selected by the Owner and conform to ANSI Standards.

3.8. PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to Manufacturer and Installer that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.

B. Repair damage to galvanized finishes with zinc rich paint recommended by manufacturer.

C. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

D. Steel conduit: Conduit that shows corrosion within the guarantee period shall be replaced.

3.9. CLEANING

A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

B. After conduits and accessories have been installed, and concreting operations completed, conduit runs shall be satisfactorily cleared of obstructions and foreign matter. Defects which might damage cable upon installation shall be corrected. Where new conduits

installed are connected to existing conduits or new conduits installed by others, the entire run to the nearest box or other termination point shall be cleaned.

END OF SECTION

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IDENTIFICATION FOR ELECTRICAL SYSTEMS
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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. This Section includes electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

B. This section includes labeling of all terminations and related subsystems; including, but not limited to, nameplates, wire and cable markers, labeling and identification of cables, equipment and other products.

1.3. SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4. QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

D. Comply with applicable EIA/TIA Standards.

E. Comply with OSHA Standards.

1.5. DEFINITIONS

A. Emergency systems include, but are not limited to, generator circuits and systems, fire alarm systems, exit sign circuits, emergency lighting circuits, etc.

PART 2. PRODUCTS

2.1. RACEWAY AND CABLE LABELS

A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

1. Color: Black letters on orange field.

2. Legend: Indicates voltage and service as well as circuit designation for all feeders.

B. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend, over laminated

with a clear, weather- and chemical-resistant coating.

C. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.

D. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 3/4 inch wide, in appropriate colors for system voltage and phase.

E. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

2.2. WIRING DEVICE FACEPLATE LABELS

A. Adhesive Labels:

1. Thermal transfer printable, clear polyester material with glossy finish, 1/2" high, width as required. Printed lettering shall be 1/4" high black text.

2. Labels shall be backed with permanent acrylic adhesive and shall exhibit good adhesion to many metal and other types of surfaces, including textured surfaces and low surface energy plastics.

3. Labels shall be resistant to humidity, temperature and UV light.

4. Labels shall meet requirements of UL 969 Labeling and Marking Standard and shall be RoHS compliant.

5. Provide Brady B-432 Series, or approved equal by acceptable manufacturer.

2.3. EQUIPMENT NAMEPLATES

A. General Nameplate Requirements:

1. Use colors prescribed by ANSI A13.1, NFPA 70 and as follows:

a. Normal Power System: White lettering on black background.

2. Backed with adhesive material formulated for the type of surface, intended use and installed location. 1/4-inch grommets in corners for mounting with self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

B. Nameplates for Dry, Interior Locations:

1. Engraving stock, melamine 3-layer plastic laminate.

2. Minimum 1/16-inch (1.6-mm) thick for signs up to 20 sq. inches (129 sq. cm)

3. Minimum 1/8-inch (3.2-mm) thick for signs larger than 20 sq. inches.

C. Nameplates for Damp/Wet Interior and Exterior Locations:

1. Weather-resistant, UV Resistant, minimum 1/8-inch (3.2-mm) thick.

D. Refer to Contract Drawings for typical nameplate details.

E. Refer to Paragraph "Equipment Identification Nameplates" under Part 3 of this Section for installation requirements.

2.4. MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength: 50 lb (22.3 kg) minimum.

3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

4. Color: According to color-coding.

B. Paint: Formulated for the type of surface and intended use.

1. Primer for Galvanized Metal: Single-component acrylic formulated for galvanized surfaces.

2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.

3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.

4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

PART 3. EXECUTION

3.1. INSTALLATION

A. General:

1. Where mixed voltages are used in one building (e.g., 480 volts, 208 volts), each new piece of equipment, including but not limited to, panelboard(s), safety switches, outlet/pull/junction boxes, etc., on each system must be labeled for voltage in addition to other requirements listed herein.

2. All branch circuit panelboards must be identified with the same designation used in the circuit directory in the Main Switchboard.

3. Before attaching labels, clean all surfaces with the label manufacturer's recommended cleaning agent.

4. Install all labels firmly, as recommended by the label manufacturer.

5. Labels attached to wiring device faceplates and electrical equipment shall be

installed plumb and neatly on all equipment.

6. Install nameplates parallel to equipment lines.

7. Secure nameplates to equipment fronts unless otherwise noted.

8. Secure nameplate to inside of recessed panelboards in finished locations.

9. Embossed tape will not be permitted for any application.

10. Stenciling is prohibited.

11. Labels: All labels shall be permanent and be machine-generated. NO HANDWRITTEN OR NON-PERMANENT LABELS SHALL BE ALLOWED.

12. Label size shall be appropriate for the conductor/cable size(s), and wiring device faceplate layout. All labels to be used shall be self-laminating, white/transparent vinyl and be wrapped around the cable. Flag type labels are not allowed. The labels shall be of adequate size to accommodate the circumference of the cable being labeled and properly self-laminated over the full extent of the printed area of the label.

B. Panelboard Circuit Directories:

1. Panelboards shall be equipped with equipment nameplates as specified in paragraph “Equipment Identifications Labels” in this Section.

2. Panelboards shall have accurate typed circuit directories indicating exactly what each branch circuit serves.

3. The Contractor shall provide up to date circuit directories in new and existing panelboards, indicating all deletions and additions, and to note the date of all changes on the directory.

4. The circuit directories shall reflect the actual room numbers. Directories indicating the reference room numbers on the contract drawings or in the panelboard schedule shall not be acceptable.

5. The circuit directories shall include the name, address, and contact information for the Electrical/Division 26 Contractor.

6. If at anytime after occupancy the circuit directories are found to be incorrect due to negligence by the installer, then the Contractor shall trace out circuits, and correct the directories at no additional cost to the Owner.

C. Miscellaneous Identification:

1. Individual circuit breakers in switchboards: 1/4-inch text (6 mm); identify circuit and load served, including location.

2. Individual enclosed switches, and motor starters: 1/4-inch text (6 mm); identify load served, circuit and voltage.

3. Junction boxes: 1/4-inch text (13 mm); identify load served, circuit and voltage.

D. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

E. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

F. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

G. Self-Adhesive Identification Products: Clean surfaces before applying.

H. Caution Labels for Boxes and Enclosures: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover. Install label on inside face of door or cover in finished spaces.

I. Circuit Identification Labels on Boxes: Install labels externally.

1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.

2. Concealed Boxes: Plasticized card-stock tags.

3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.

J. Feeder and Branch-Circuit Conductors: Color-code throughout the secondary electrical system. Refer to Division 26 Section 26 05 19 “Low Voltage Electrical Power Conductors and Cables” for additional requirements.

K. Power-Circuit and Control Wire Identification: Metal tags or aluminum, wraparound marker bands for each conductor, cables, feeders, and power circuits in vaults, panelboard gutters, outlet boxes, junction boxes, pullboxes, switchboard rooms, and at load connections. Identify with branch circuit or feeder number for power and lighting circuits and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.

1. Legend: 1/4-inch- (6.4-mm-) steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.

2. Tag Fasteners: Nylon cable ties.

3. Band Fasteners: Integral ears.

L. Apply identification to conductors as follows:

1. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.

2. Multiple Control and Communication Circuits in the Same Enclosure: Identify

each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

M. Apply warning, caution, and instruction signs as follows:

1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

N. Equipment Nameplates

1. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification.

2. Install on each piece of equipment provided with factory installed disconnecting means, e.g. ERV units, where a separate external disconnecting means is not provided under Division 26.

3. Install on each variable frequency drive serving pumps, fans, etc..., provided by others where a separate motor controller is not provided under Division 26.

4. Unless otherwise noted, nameplates shall identify equipment designation(s), voltage rating, and source (including source locations).

5. Nameplates for disconnect switches, motor starters, etc…, shall indicate the designation of the load served as the “equipment designation”.

6. In general, nameplates requiring one or two lines of text shall be 1-1/2 inches high. Labels requiring three lines of text shall be 2 inches high. The first line of text, which shall indicate equipment designation/load served, shall utilize ½ inch high lettering. Remaining lines of text, which shall indicate voltage ratings and source information shall utilize ¼ inch high lettering. Refer to the Drawings for nameplate examples.

7. Apply nameplates to each unit of the following categories of equipment:

a. Panelboards.
b. Switchboards.
c. Disconnect Switches.
d. Motor Controllers.
e. Electrical Cabinets and Enclosures.

O. Fire Alarm: Junction box covers shall be painted red, except in finished spaces where they shall be painted to match adjacent surfaces. Box covers shall have a type written label to read “Fire Alarm” in accordance with requirements of NFPA 72.

P. Surfaces shall be cleaned and painted, if specified, before applying markings.

Q. Place markings so that they are visible from the floor.

R. Protect finished identification to ensure that markings are clear and legible when project is turned over to the Owner.

END OF SECTION

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SWITCHBOARDS
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SECTION 26 24 13
SWITCHBOARDS

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 modifications to existing circuit breaker type service and distribution switchboards rated 600 volts and less. Modifications include, but are not limited to the following:

1. Provide new circuit breaker(s) in existing switchboard(s).

B. Related Sections include the following:

1. Division 26 Section 26 05 00 “Common Work Results for Electrical” for general and installation materials and methods.

2. Division 26 Section 26 05 53 “Identification for Electrical Systems” for identification materials for labeling switchboards, including, but not limited to equipment nameplates.

1.3. ALTERNATES

A. Refer to Division 01, Section 01 23 00 “Alternates”, for description of work under this Section affected by Alternates.

1.4. REFERENCES

A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

B. American Society of Testing Materials (ASTM):

1. ASTM E 329, “Standard Specification for Agencies Engaged in the Testing and/or inspection of Materials Used in Construction.”

C. Federal Specifications (FS):

1. FS W-C-375, “Circuit Breakers, Molded Case, Branch Circuit and Service.”

D. InterNational Electrical Testing Association (NETA):

1. NETA ATS, “Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.”

E. International Organization for Standardization (ISO):

1. ISO 9001, "Quality Management Systems – Requirements."

F. National Electrical Contractors Association (NECA):

1. NECA 400, "Standard for Installing and Maintaining Switchboards."

G. National Electrical Manufacturers Association (NEMA):

1. NEMA PB 2, "Deadfront Distribution Switchboards."

2. NEMA PB 2.1, "General Instructions for Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less."

H. National Fire Protection Association (NFPA):

1. NFPA 70, "National Electrical Code."

2. NFPA 70B, "Electrical Equipment Maintenance."

3. NFPA 70E, "Standard for Electrical Safety in the Workplace."

I. Underwriters Laboratories, Inc. (UL):

1. UL 489, "Standard for Molded-Case Circuit Breakers and Circuit Breaker Enclosures."

2. UL 891, "Standard for Dead-Front Switchboards."

1.5. SUBMITTALS

A. Product Data: Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications.

1. Submit product data for each overcurrent protective device, accessory, and component indicated.

2. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Quality Control Submittals: Submit field quality control test reports.

C. Contract Closeout Submittals:

1. Operation and Maintenance Data: Submit operation and maintenance data for switchboards to include in operation and maintenance manuals specified in Division 01.

2. Warranty Data: Submit manufacturer's standard warranty documents.

1.6. QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of switchboards of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of 20 years. The manufacturer shall be ISO 9001 certified and shall be designed to internationally accepted standards.

B. Installer Qualifications: Installer shall be a firm that shall have a minimum of five years of successful installation experience with projects utilizing switchboards similar in type and scope to that required for this Project.

C. Testing Agency Qualifications: In addition to the requirements specified in Division 01 Section 01 40 00 “Quality Requirements”, an independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or shall be a full-member company of the International Electrical Testing Association.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3 of this Section.

D. Listing and Labeling: Provide switchboard assemblies specified in this Section that are listed and labeled.

1. The Terms Listed and Labeled: As defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A Nationally Recognized Testing Laboratory as defined in OSHA Regulation 1910.7.

1.7. DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project site in supplier’s or manufacturer’s original wrappings and containers, labeled with supplier’s or manufacturer’s name, material or product brand name, and lot number, if any.

B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.8. PROJECT CONDITIONS

A. Verify Dimensions: Verify NEC and all Code requirements by field measurements.

B. Revise locations of new circuit breakers in existing switchboard from those indicated as required to suit Project conditions.

1.9. WARRANTY

A. Manufacturer shall warrant equipment to be free from defects in materials and workmanship for two (2) years from date of substantial completion.

PART 2. PRODUCTS

2.1. MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, supply equipment from the following manufacturer to match existing: No other manufacturers are acceptable.

1. Eaton Corporation; & Cutler-Hammer Products.

2.2. OVERCURRENT PROTECTIVE DEVICES

A. Overcurrent protective devices include, but are not limited to, the following:

1. Electronic trip circuit breakers.

2. Thermal magnetic circuit breakers.

B. Molded-Case Circuit Breaker Features and Accessories:

1. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting capacity rating to meet available fault current.

2. Lugs: Mechanical style, suitable for quantity, size/gauge, and material of conductors indicated.

3. Application Listing: Appropriate for application, including switching fluorescent lighting loads (Type SWD) or heating, air-conditioning, and refrigerating equipment (Type HACR).

4. Handle Padlock Attachment: All circuit breakers in switchboards shall be equipped with fixed handle padlock attachment to allow padlocking the circuit breaker in the ON or OFF position.

2.3. DISTRIBUTION SECTION DEVICES – GROUP MOUNTED CIRCUIT BREAKERS THROUGH 1200A

A. General Requirements

1. Circuit breaker(s) shall be group mounted plug-on with mechanical restraint on a common pan or rail assembly.

2. Circuit breaker(s) equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breaker(s) shall be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners. Circuit breaker(s) of different frame sizes shall be capable of being mounted across from each other.

3. Line side circuit breaker connections are to be jaw type.

4. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.

B. Electronic Trip Molded Case Circuit Breakers

1. Electronic trip, molded case, 80% rated circuit breaker(s) with Micrologic® interchangeable ammeter trip unit and the following time/current response adjustments:

   a. Long Time Pickup
   b. Long Time Delay
   c. Short Time Pickup
   d. Short Time Delay
   e. Instantaneous Settings

2. Circuit breakers where the highest continuous current trip setting can be adjusted to 1200A or higher, shall be equipped with arc energy reducing maintenance settings, in compliance with National Electrical Code Article 240.87.

3. All adjustments shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.

4. Circuit breaker trip system shall be micro-processor based true RMS sensing designed with sensing accuracy through the thirteenth (13th) harmonic.

5. Sensor ampere trip ratings shall be as indicated on the Drawings.

6. Local visual trip indication for overload, short circuit trip occurrences.

7. Long time pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.

C. Thermal Magnetic Circuit Breakers

1. Molded case circuit breakers shall have integral thermal and instantaneous magnetic trip in each pole.

2. Ampere ratings shall be as shown on the Drawings.

3. Ampere interrupting capacity ratings shall be as shown on the Contact Drawings, but not less than 35,000 AIC RMS symmetrical amperes at rated voltage.

2.4. DISTRIBUTION SECTION DEVICES – INDIVIDUALLY MOUNTED CIRCUIT BREAKERS GREATER THAN 1200A

A. General Requirements

1. Circuit breaker(s) shall be group mounted plug-on with mechanical restraint on a common pan or rail assembly.

2. Circuit breaker(s) equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breaker(s) shall be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners. Circuit breaker(s) of different frame sizes shall be capable of being mounted across from each other.

3. Line side circuit breaker connections are to be jaw type.

4. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.

B. Electronic Trip Molded Case Circuit Breakers

1. Electronic trip, molded/insulated case, 80% rated circuit breaker(s) with Micrologic® interchangeable ammeter trip unit and the following time/current response adjustments:

a. Long Time Pickup
b. Long Time Delay
c. Short Time Pickup
d. Short Time Delay
e. Instantaneous Settings

2. Circuit breakers where the highest continuous current trip setting can be adjusted to 1200A or higher, shall be equipped with arc energy reducing maintenance settings, in compliance with National Electrical Code Article 240.87.

3. All adjustments shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.

4. Circuit breaker trip system shall be micro-processor based true RMS sensing designed with sensing accuracy through the thirteenth (13th) harmonic.

5. Sensor ampere trip ratings shall be as indicated on the Drawings.

6. Local visual trip indication for overload, short circuit and ground fault trip occurrences.

7. Long time pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.

2.5. IDENTIFICATION

A. Nameplates: Engraved nameplates with 1/4" high white lettering shall be furnished for all new feeder circuits. Nameplates shall give item designation and circuit number.

B. Refer to Division 26 Section 26 05 53 "Identification for Electrical Systems" for additional information.

PART 3. EXECUTION

3.1. EXAMINATION

A. Examine existing switchboard for compliance with installation tolerances and other conditions affecting performance.

1. Do not proceed with installation until unsatisfactory conditions have been corrected.

2. Verify dimensions of mounting spaces intended to receive new circuit breakers to

confirm new circuit breakers fit at intended location.

3.2. INSTALLATION

A. Install new overcurrent protective devices in existing switchboards as required.

3.3. CONNECTIONS

A. Connect new circuit breakers to wiring systems and to ground as indicated and instructed by manufacturer. Tighten electrical connectors and terminals, including screws and bolts, according to manufacturer's published torque tightening values. Use a calibrated torque wrench. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Neutral and ground conductors shall be isolated and terminated only at their respective bus bars. There shall only be one neutral-ground connection in service-entrance equipment by means of a removable main bonding jumper. Neutral and ground terminations at one bus bar shall not be acceptable.

3.4. IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs as specified in Division 26 Section 26 05 53 “Identification for Electrical Systems”.

B. Label each new circuit breaker with nameplate as specified herein and detailed on the drawings.

3.5. FIELD QUALITY CONTROL

A. Visual and Mechanical Inspection: Include the following inspections and related work:

1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and switchboard schedules.

2. Clean new devices using Manufacturer’s approved methods and materials.

3. Verify that new nameplates are installed and accurate.

4. Exercise and perform operational tests of all new mechanical components and other operable devices in accordance with manufacturer’s instruction manual.

5. Check alignment and fit of new components.

6. Check tightness of new bolted electrical connections with calibrated torque wrench. Refer to manufacturer’s instructions for proper torque values.

7. Perform visual and mechanical inspection and related work for new over-current protective devices.

B. Switchboard Electrical Testing: After installing switchboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements

1. Inspect new components for cleanliness, mechanical and electrical integrity, and damage or deterioration. Verify that temporary shipping bracing has been removed. Include internal inspection through access panels and covers.

2. Inspect new bolted connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A and UL 486B.

3. Protective Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system configuration and parameters. Where discrepancies are found, recommend final protective device ratings and settings. Use accepted ratings or settings to make the final system adjustments.

4. Make continuity tests of each new circuit. Refer to Division 26 Section 26 05 19 “Low Voltage Electrical Power Conductors and Cables” for testing specific to feeder conductors.

5. Perform ground resistance test on system and new equipment ground connections

6. Test new over-current protective devices.

7. Infrared Scanning: Perform an infrared scan of all new electrical connections in each switchboard, as follows:

    a. Remove equipment covers so terminations are accessible to scanner.
    b. Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values.
    c. Provide calibration record for device.
    d. Compare test results with specified performance or manufacturer’s data. Correct deficiencies identified by tests and retest.
    e. Prepare reports certified by testing agency identifying equipment checked and describing results of tests. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

8. Perform all other manufacturer specific tests as indicated in manufacturer’s literature.

9. Test Labeling: On satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.

10. Submit all test reports to the Engineer for review and approval.

11. Provide copy of all test reports in the O&M manual.

3.6. CLEANING

A. Upon completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

END OF SECTION

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PANELBOARDS
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SECTION 26 24 16
PANELBOARDS

PART 1. GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provision of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section

1.2. SUMMARY

A. This Section includes lighting and power panelboards and associated auxiliary equipment rated 600 V and less.

B. Provide design and engineering, labor, material, equipment, related services and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for panelboards as required for the complete performance of the work, and as shown on the Drawings and as specified herein.

C. Panelboards shall be fully rated for the AIC identified on the panelboard schedules on the Contract Drawings.

D. Related Sections include the following:

1. Division 26 Section 26 05 00 “Common Work Results for Electrical” for general materials and installation methods.

2. Division 26 Section 26 05 53 “Identification for Electrical Systems” for labeling materials.

1.3. ALTERNATES

A. Refer to Division 01, Section 01 23 00 “Alternates”, for description of work under this Section affected by Alternates.

1.4. REFERENCES

A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

B. American Society of Testing Materials (ASTM):

1. ASTM E 329, “Standard Specification for Agencies Engaged in the Testing and/or inspection of Materials Used in Construction.”

C. Federal Specifications (FS):

1. FS W-C-375, “Circuit Breakers, Molded Case, Branch Circuit and Service.”

D. International Electrical Testing Association (NETA):

1. NETA ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems."

E. International Organization for Standardization (ISO):

1. ISO 9001, "Quality Management Systems – Requirements."

F. National Electrical Contractors Association (NECA):

1. NECA 407, "Standard for Installing and Maintaining Panelboards."

G. National Electrical Manufacturers Association (NEMA):

1. NEMA PB 1, "Panelboards."

2. NEMA PB 1.1, "General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less."

3. NEMA PB 1.2, "Application Guide for Ground Fault Protective Devices."

H. National Fire Protection Association (NFPA):

1. NFPA 70, "National Electrical Code."

2. NFPA 70B, "Electrical Equipment Maintenance."

3. NFPA 70E, "Standard for Electrical Safety in the Workplace."

I. Underwriters Laboratories, Inc. (UL):

1. UL 50, "Standard for Enclosures for Electrical Equipment."

2. UL 67, "Standard for Panelboards."

3. UL 489, "Standard for Molded-Case Circuit Breakers and Circuit Breaker Enclosures."

1.5. SUBMITTALS

A. Product Data: Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications.

1. Submit product data for each type of panelboard, overcurrent protective device, accessory, and component indicated.

2. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes of individual protective devices and auxiliary components.

B. Shop Drawings: Include the following for each panelboard:

1. Dimensioned Plans: Show dimensioned enclosure plans and elevations, including required clearances and service space.

2. Component and Device Lists: Show tabulations of installed devices, features and voltage rating.

3. Single-Line Diagram: Show main- and branch-bus current ratings and short-time and short-circuit ratings of panelboards.

C. Quality Control Submittals: Submit field quality control test reports.

D. Contract Closeout Submittals:

1. Operation and Maintenance Data: Submit operation and maintenance data for panelboards to include in operation and maintenance manuals specified in Division 01.

2. Warranty Data: Submit manufacturer's standard warranty documents.

3. Panelboard Circuit Directories: For installation in panelboards. Submit final versions after load balancing.

4. Project Record Data: Record actual locations of panelboards, indicating actual branch circuit arrangement.

1.6. QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of panelboards of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of 20 years. The manufacturer shall be ISO 9001 certified and shall be designed to internationally accepted standards.

B. Installer Qualifications: Installer shall be a firm that shall have a minimum of five years of successful installation experience with projects utilizing panelboards similar in type and scope to that required for this Project.

C. Testing Agency Qualifications: In addition to the requirements specified in Division 01 Section 01 40 00 "Quality Requirements", an independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or shall be a full member company of the International Electrical Testing Association.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3 of this Section.

D. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms Listed and Labeled: As defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A Nationally Recognized Testing Laboratory as defined in OSHA Regulation 1910.7.

1.7. DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and lot number, if any.

B. Deliver in shipping splits of lengths that can be moved past obstructions in delivery path.

C. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

D. Store so condensation will not occur on or in panelboards. Provide temporary heaters as required to avoid condensation.

E. Handle panelboards according to NEMA PB 1.1. Use only factory-installed lifting provisions.

1.8. PROJECT CONDITIONS

A. Environmental Requirements: Do not install switchboards until space is enclosed and weatherproof, wet work space is completely and nominally dry, overhead work is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.

B. Verify Dimensions: Verify NEC and all Code clearance requirements by field measurements. Locate switchboard to meet installation tolerances.

C. Determine suitable path for moving switchboard into place considering Project conditions.

D. Revise locations and elevations from those indicated as required to suit Project conditions.

1.9. WARRANTY

A. Manufacturer shall warrant equipment to be free from defects in materials and workmanship for the lesser of one (1) year from date of installation or eighteen (18) months from date of purchase.

1.10. EXTRA MATERIALS

A. Keys: Provide two (2) spares of each type of panelboard cabinet lock.

B. Touchup Paint: Provide one (1) standard size canisters of manufacturer's touch-up paint for every ten (10) panelboards, finish to match standard enclosure finish as specified herein. Furnish at least one (1) canister of touch-up paint.

PART 2. PRODUCTS

2.1. MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, supply equipment from one of the following manufacturers; no other manufacturers are acceptable:

1. Square D Company. (Basis of Design)

2. Eaton Corp.; Cutler-Hammer Products.

3. Siemens Energy & Automation Inc.

4. General Electric (GE)

2.2. FABRICATION AND FEATURES

A. Enclosures: Provide steel enclosures, in compliance with NEMA PB1, suitable for flush- or surface-mounting as indicated on the Drawings. Type as indicated on the Drawings, unless otherwise indicated to meet environmental conditions at installed location as indicated below:

1. Dry, Interior Locations: NEMA 1

B. Enclosure Finish for Indoor Units: A minimum of one (1) coat of factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

C. Front: Secured to box with concealed trim clamps, unless otherwise indicated. Front for surface-mounted panelboards shall be same dimensions as box. Fronts for flush-mounted panelboards shall overlap box, unless otherwise indicated.

D. Buses and Connections: Three phase, four wire, unless otherwise indicated.

1. Bus Composition: Silver-plated or tin-plated copper, hard-drawn, minimum of 98 percent conductivity. Plating shall be applied continuously to bus work. The panelboard bussing shall be of sufficient cross-sectional area to meet UL 67 temperature rise requirements. The phase and neutral through-bus shall have an ampacity as shown on the Drawings. Coordinate bus short circuit rating with available fault current. Size in accordance with NEMA PB 1.

2. Phase and Neutral Buses: Provide mechanical lugs to accommodate the quantity, size, and material of the conductors shown on the Contract Drawings.

3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box.

4. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity the entire length of the switchboard main and distribution sections. Provide for future extensions from both ends.

5. Neutral Buses: 100 percent of the ampacity of the phase buses, except as indicated, and equipped with approved pressure connectors for outgoing circuit neutral cables.

E. Future Devices: Equip with mounting brackets, supports, bus connections, and appurtenances for the overcurrent protective device ampere ratings indicated on the Drawings.

F. Directory Frame: Clear plastic cardholder, mounted inside each panelboard door.

G. Service Equipment Approval: Listed for use as service equipment for panelboards with main service disconnect.

H. Special Features: Include the following features for panelboards as indicated:

1. Subfeed: Over-current protective device or lug provision as indicated.

2. Feed-Through Lugs: Provide mechanical lugs to accommodate the quantity, size, and material of the conductors shown on the Contract Drawings.

3. Gutter Barrier: Arranged to isolate section of gutter as indicated.

2.3. OVERCURRENT PROTECTIVE DEVICES

A. Overcurrent protective devices include, but are not limited to, the following:

1. Electronic trip circuit breakers.

2. Thermal magnetic circuit breakers.

B. Molded-Case Circuit Breaker Features and Accessories:

1. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting capacity rating to meet available fault current.

2. Lugs: Mechanical style, suitable for quantity, size/gauge, and material of conductors indicated.

3. Application Listing: Appropriate for application, including switching lighting loads (Type SWD) or heating, air-conditioning, and refrigerating equipment (Type HACR).

4. Handle Padlock Attachment: Circuit breakers in panelboards shall be equipped with fixed handle padlock attachment to allow padlocking the circuit breaker in the OFF only position at the following locations:

a. Main circuit breakers in all panelboards.
b. Branch or sub-feed circuit breakers serving variable frequency drives.
c. Other locations as indicated on the Contract Drawings.

5. Handle Clamp Attachment: Circuit breakers in panelboards shall be equipped with removable handle clamp attachments to prevent accidental operation of the circuit breaker at the following locations:

a. Branch circuit breakers serving emergency lighting and exit signs.
b. Branch circuit breakers serving fire alarm equipment.
c. Other locations as indicated on the Contract Drawings.

2.4. LIGHTING AND APPLIANCE PANELBOARDS

A. Interior

1. Minimum short-circuit current ratings shall be as indicated on the Contract Drawings, but not less than 10,000 AIC RMS symmetrical amperes for 120/208V panelboards.

2. Provide one (1) continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors suitable for plug-on or bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current ratings shall be determined by heat rise tests conducted in accordance with UL 67. Bus bar plating shall run the entire length of the bus bar.

3. Panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Article 230.

4. All current carrying parts shall be insulated from ground and phase to phase by high dielectric strength thermoplastic.

5. Interior trim shall be of dead front construction to shield user from energized parts. Dead front trim shall have preformed twist-outs covering unused mounting space.

6. Interiors shall be field convertible for top or bottom incoming feed.

7. Main circuit breakers in 100A interiors shall be horizontally mounted. Main circuit breakers over 100A shall be vertically mounted.

8. Main lug interiors up to 400 amperes shall be field convertible to main breaker.

B. Main Circuit Breakers

1. Main circuit breakers shall have an over-center, trip free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and instantaneous magnetic trip elements in each pole. Each thermal element shall be true RMS sensing and be factory calibrated to operate in a 40 degrees C ambient environment. Thermal elements shall be ambient compensating above 40 degrees C.

2. Two and three pole circuit breakers shall have common tripping of all poles. Circuit breakers frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker that allows the user to simultaneously select the desired trip level of all poles. Circuit breakers shall have a push to trip button for maintenance and testing purposes.

3. Breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be UL listed for reverse connection without restrictive line or load markings.

C. Branch Circuit Breakers

1. Molded case branch circuit breakers shall have bolt-on type bus connectors.

2. Circuit breakers shall have an over-center toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and

instantaneous magnetic trip elements in each pole. Two and three pole circuit breakers shall have common tripping of all poles.

3. There shall be two forms of visible trip indication. The breaker handle shall reside in a position between ON and OFF. In addition, there shall be a red VISI TRIP indicator appearing in the clear window of the circuit breaker housing.

4. Circuit breakers serving transformers or other panelboards shall be equipped with factory-installed, fixed, handle padlock attachment to allow padlocking circuit breakers in the OFF only position.

D. Enclosures

1. Type 1 Enclosures

a. Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Galvannealed steel will not be acceptable.
b. Boxes shall have removable end-walls with knockouts located on one end. Boxes shall have welded interior mounting studs.
c. Fronts shall meet strength and rigidity requirements per UL 50 standards. Front shall be finished with ANSI 49 gray baked enamel electrodeposited over cleaned phosphatized steel.
d. Panelboards shall have hinged front cover with entire front trim hinged to box with standard door within hinged front cover.
e. Front shall not be removable with the door locked.
f. Doors on front shall have rounded corners and edges shall be free of burrs.
g. A clear plastic directory card holder shall be mounted on the inside of the door.
h. All lock assemblies shall be keyed alike, one (1) key shall be provided with each lock.

E. Basis of Design – Square D Company, NQ/NF Series Panelboards.

2.5. IDENTIFICATION

A. Nameplates: Engraved nameplates shall be provided for all panelboards. Nameplates shall give item designation and circuit number as well as frame size and appropriate trip rating. Furnish Master Nameplate giving panelboard designation, voltage ampere rating, short circuit rating, manufacturer’s name, general order number and item number.

B. Panelboards used as service-entrance equipment shall be labeled as the same.

C. Refer to Division 26 Section 26 05 53 "Identification for Electrical Systems” for additional information.

PART 3. EXECUTION

3.1. EXAMINATION

A. Examine elements and surfaces to receive switchboard for compliance with installation tolerances and other conditions affecting performance of panelboards.

1. Do not proceed with installation until unsatisfactory conditions have been corrected.

2. Verify dimensions of panelboard and working space clearances.

3.2. INSTALLATION

A. Install panelboards and accessory items according to NEMA PB 1.1.

B. Mounting: Plumb and rigid without distortion of box**.**

C. Panelboard dead fronts shall remain intact except where tabs are removed for circuit breakers. Install filler plates in unused pole spaces not filled by a circuit breaker that are accidentally opened. Do not remove all tabs in dead front and fill the same with filler plates.

D. Wiring in Panelboard Gutters: Arrange conductors into groups, and bundle and wrap with wire ties after completing load balancing.

E. Two or three pole circuit breakers shall be common trip type. Single pole breakers with handle ties will not be permitted.

F. Tandem circuit breakers will not be permitted.

G. Provide ground buses in panelboards as indicated on the Drawings. Ground bus shall be similar in all respects to neutral bus.

H. Provide handle clamps for all branch circuit breakers **[or switches]** serving telephone and communications equipment, refrigerators, exit signs, fire alarm system controls, etc. to prevent accidental operation.

I. Replacement circuit breakers shall be obtained from the original manufacturer through an authorized factory distributor, complete with full factory warranty. Original manufacturer product data shall be submitted for review.

J. Height: Six-feet, six-inches to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above the floor. Top breaker maximum height not to exceed 6 feet 7 inches per NEC Article 404.8.

3.3. GROUNDING

A. Make equipment grounding connections for panelboards as indicated.

B. Provide ground continuity to main electrical ground bus as indicated.

3.4. CONNECTIONS

A. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Neutral and ground conductors shall be isolated and terminated only at their respective bus

bars. There shall only be one neutral-ground connection in service-entrance equipment by means of a removable main bonding jumper. Neutral and ground terminations at one bus bar shall not be acceptable.

3.5. IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs as specified in Division 26 Section 26 05 53 “Identification for Electrical Systems”.

B. Panelboard Nameplates: Label each panelboard with engraved laminated-plastic or metal nameplates mounted with corrosion-resistant screws. Refer to Division 26 Section 26 05 53 “Identification for Electrical Systems” for nameplate requirements.

C. Panelboard Circuit Directories: Provide a typewritten directory, indicating plainly what each branch circuit of the panelboard serves and where. Provide additional information as required by NEC. Spaces and spare breakers shall be written in pencil. Copying of Contract Drawing Panel Schedules and Descriptions shall not be acceptable. Circuit directory shall reflect final circuit connections, loads and locations after balancing of panelboard loads.

3.6. FIELD QUALITY CONTROL

A. Visual and Mechanical Inspection: Include the following inspections and related work:

1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.

2. Clean devices using Manufacturer’s approved methods and materials.

3. Verify that panelboard nameplates are installed and accurate.

4. Verify that panelboard phase identification nameplates are installed.

5. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer’s instruction manual.

6. Check panelboard mounting, area clearances, and alignment and fit of components.

7. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer’s instructions for proper torque values.

8. Perform visual and mechanical inspection and related work for over-current protective devices.

B. Panelboard Electrical Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Inspect accessible components for cleanliness, mechanical and electrical integrity, and damage or deterioration. Verify that temporary shipping bracing has been removed. Include internal inspection through access panels and covers.

2. Inspect bolted electrical connections for tightness according to manufacturer's

published torque values or, if not available, those specified in UL 486A and UL 486B.

3. Protective Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system configuration and parameters. Where discrepancies are found, recommend final protective device ratings and settings. Use accepted ratings or settings to make the final system adjustments.

4. Make continuity tests of each circuit. Refer to Division 26 Section 26 05 19 “Low Voltage Electrical Power Conductors and Cables” for testing specific to feeder conductors.

5. Perform ground resistance test on system and equipment ground connections

6. Test main and subfeed over-current protective devices.

7. Infrared Scanning: Perform an infrared scan of all electrical connections in each panelboard, as follows:

   a. Remove equipment covers so terminations are accessible to scanner.
   b. Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values.
   c. Provide calibration record for device.
   d. Compare test results with specified performance or manufacturer’s data. Correct deficiencies identified by tests and retest.
   e. Prepare reports identifying equipment checked and describing results of tests. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

8. Test Labeling: On satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.

9. Submit all test reports to the Engineer for review and approval.

10. Provide copy of all test reports in the O&M manual.

3.7. CLEANING

A. Upon completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.8. PROTECTION

A. Provide final protection and maintain conditions in a manner that shall ensure that the panelboard(s) shall be without damage at time of Substantial Completion.

END OF SECTION

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WIRING DEVICES
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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. Straight-blade receptacles.

2. GFCI receptacles.

3. Toggle switches.

4. Device plates.

1.3. DEFINITIONS

A. GFCI: Ground-Fault Circuit Interrupter.

B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

1.4. SUBMITTALS

A. Product Data: For each product specified, indicating configurations, finishes, dimensions, and manufacturer's instructions.

B. Maintenance Data: For materials and products to include in maintenance manuals specified in Division 01.

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.

B. Comply with NFPA 70.

C. Comply with NECA Standard of Installation.

D. Codes: Provide wiring devices conforming to the following:

1. American National Standards Institute (ANSI): Provide lugs and receptacle devices constructed in accordance with ANSI C73, Attachment Plugs and Receptacles, Dimensions of.

2. Institute of Electrical and Electronics Engineers (IEEE): Construct and install

wiring devices in accordance with requirements of IEEE 241, Recommended Practice for Electric Power Systems in Commercial Building.

3. National Electrical Manufacturers Association (NEMA): Provide wiring devices constructed and configured in accordance with the requirements of

   a. WD1: General Requirements for Wiring Devices
   b. WD5: Special Purpose Wiring Devices
   c. WD6: Wiring Devices - Dimensional Requirements.

4. National Fire Protection Association (NFPA): Comply with NFPA 70, National Electrical Code, as applicable to construction and installation of electrical wiring devices.

5. Underwriters Laboratories, Inc. (UL): Provide wiring devices which are UL listed and comply with the requirements of:

   a. 20: General-Use Snap Switches.
   b. 498: Attachments, Plugs and Receptacles
   c. 514A: Metallic Outlet Boxes.
   d. 514B: Fittings for Conduit and Outlet Boxes.
   e. 514C: Non-Metallic Outlet Boxes, Flush-Device Boxes, and Covers
   f. 943: Ground-Fault Circuit Interrupters

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:

1. Wiring Devices:

   a. Hubbell, Inc.; Wiring Devices Division
   b. Pass & Seymour/Legrand; Wiring Devices Division
   c. Leviton Manufacturing Co., Inc.
   d. Eaton/Cooper; Wiring Devices Division
   e. Lutron Electronics, Inc.

2.2. SWITCHES

A. General Requirements

1. Switches shall have the following basic features:

   a. Heavy-gauge one-piece copper alloy contact arm.
   b. Fast "make" and positive "break" to minimize arcing.
   c. Heavy-duty bumper pads for quiet operation.
   d. High strength thermoplastic polycarbonate toggle.
   e. Oversized silvery alloy contacts for long life and heat dissipation.

f. Nickel-plated steel strap with integral ground.
g. Auto-ground clip to assure positive ground.

B. Toggle Switches

1. Toggle switches shall be quiet-type, extra heavy-duty, horsepower-rated, industrial grade, 120/277V, 20A: Comply with NEMA WD 1, UL 20 and Federal Specification W-S-896.

2. Hubbell HBL1221 (single-pole), HBL1222 (two-pole), HBL1223 (three-way), HBL1224 (four-way), Pass & Seymour PS20AC1 (single-pole), PS20AC2 (two-pole), PS20AC3 (three-way), PS20AC4 (four-way), or approved equal by acceptable manufacturer.

C. Illuminated Toggle Switches (Light On with Load Off)

1. Illuminated toggle switches shall be quiet-type, extra heavy-duty, horsepower-rated, industrial grade, 120/277V, 20A, with clear illuminated toggle, lighted with load off.

2. Comply with NEMA WD 1, UL 20 and Federal Specification W-S-896.

3. Hubbell HBL1221ILC (single-pole), HBL1223ILC (three-way), Pass & Seymour PS20AC1-CSL (single-pole), PS20AC3-CSL (three-way), or approved equal by acceptable manufacturer.

D. Pilot Lighted Switches (Light On with Load On)

1. Pilot lighted switches shall be quiet-type, extra heavy-duty, horsepower-rated, industrial grade, 120/277V, 20A, with red illuminated toggle, lighted with load on.

2. Comply with NEMA WD 1, UL 20 and Federal Specification W-S-896.

3. Hubbell HBL1221PL (single-pole), HBL1222PL (two-pole), HBL1223PL (three-way), Pass & Seymour PS20AC1RPL (single-pole), PS20AC2RPL (two-pole), PS20AC3RPL (three-way), or approved equal by acceptable manufacturer.

E. Lockable Switch Handle Guards

1. Provide handle guards with provisions for padlocking at all toggle switches serving as disconnecting means and where indicated on the Drawings.

2. Handle guards shall be steel construction, and shall mount directly over standard switch faceplates.

3. Provide Square D Class 2510 FL1, or approved equal by listed manufacturer.

2.3. FINISHES

A. Wiring device catalog numbers in Section text do not designate device color. Device colors shall be as follows, unless otherwise indicated elsewhere in the Specifications and Drawings or as required by NFPA or device listing:

1. Wiring Devices connected to Normal Power System: White.

2.4. DEVICE PLATES

A. Device plates shall be provided for all switches and receptacles. Device plates shall be as manufactured to fit each type of single device, to fit devices which are ganged together, and they shall be same manufacturer as wiring devices with finish as follows:

1. Material for Unfinished Spaces: Galvanized steel, unless otherwise noted.

2. Material for Finished Spaces: 0.04-inch-thick, Type 302, satin-finished stainless steel, except as otherwise indicated.

3. Color: To match existing device plates.

4. Plate-Securing Screws: Metal with heads colored to match plate finish.

B. Covers for Receptacles in Damp and Wet Locations: Heavy-duty die-cast zinc/aluminum construction with hinged lockable lid, designed to be weatherproof while the device is in use, and listed and labeled “extra duty” for use in “wet locations”. All components shall have baked-on electrostatic, polyester, power paint finish for superior corrosion resistance. Covers shall comply with NEC Article 406.9(B).

1. Duplex/GFCI Receptacles – Pass & Seymour Model No. WIUCAST1 or approved equal by Hubble, Intermatic, or other listed manufacturer.

C. Covers for Switches in Damp and Wet Locations: Heavy-duty die-cast zinc/aluminum construction with actuating levers and shall mount directly over the switch. Covers shall comply with NEC Article 404.4 and shall be UL listed for use in wet locations.

1. Toggle Switches – Crouse –Hinds Model No. DS185, or approved equal.

PART 3. EXECUTION

3.1. EXAMINATION

A. Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.

1. Verify that outlet boxes are installed at proper height.

2. Verify that wall openings are neatly cut and will be completely covered by wall plates.

3. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

C. By beginning Work, accepts conditions and assume responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.2. INSTALLATION – GENERAL

A. Install devices and assemblies plumb, level, and secure.

B. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top or as required by the local Authority Having Jurisdiction.

C. Install wall plates when painting is complete.

D. Protect devices and assemblies during painting.

3.3. INSTALLATION – SWITCHES

A. Switches shall be located as indicated on the drawings, arranged singular or in gangs within 18" of the door jamb on the strike side of the door openings. Verify the door swings with the Architectural Drawings prior to rough-in.

3.4. IDENTIFICATION

A. Comply with Division 26 Section 26 05 53 “Identification for Electrical Systems”.

1. Switches: Switches shall be labeled as to lights/load controlled and with circuit number and panel identification.

2. Receptacles: All device plates shall be labeled to identify panelboard and circuit number from which served. Use machine printed, pressure sensitive, abrasion resistant label tape on face of plate and durable wire markers or tags within outlet boxes. Labels shall be clear with black lettering. Protect label from damage during construction. Replace all damaged and unclear labels.

3. Mark all conductors with the panel and circuit number serving the device at the device.

4. Mark the panel and circuit number serving the device on the back side of the device plate with a permanent marking system, machine-generated, that does not show through the front of the plate.

5. Faceplate labels shall be installed such that they are readable and do not cover any portion of the faceplate securing screw(s) or the wiring device itself.

3.5. CONNECTIONS

A. Connect wiring device grounding terminal to outlet box with bonding jumper.

B. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

C. Tighten electrical connectors and terminals according to manufacturers published torque tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.6. FIELD QUALITY CONTROL

A. Test wiring devices for proper polarity, continuity, short circuits, and ground continuity. Operate each device at least six times.

B. Replace damaged or defective components.

3.7. CLEANING

A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION

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FUSES
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SECTION 26 28 13
FUSES

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. Fuses.

B. The Electrical Contractor shall provide a complete set of fuses for all fusible equipment on the project as indicated on the Contract Documents. Final test and inspections shall be made prior to energizing the equipment.

1.3. PERFORMANCE REQUIREMENTS

A. Select fuses to provide appropriate levels of short circuit and overcurrent protection for components such as wire, cable, bus structures, and other equipment. Provide system to ensure that component damage is within acceptable levels during a fault.

B. Select fuses to coordinate with time-current characteristics of other overcurrent protective elements, such as other fuses, circuit breakers, and protective relays. Provide system to ensure that device closest to fault operates.

1.4. SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product Data for each fuse type specified. Include the following:

1. Descriptive data and time-current curves.

2. Let-through current curves for fuses with current-limiting characteristics

1.5. QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from one source and by a single manufacturer.

B. Comply with NFPA 70 for components and installation.

C. Listing and Labeling: Provide fuses specified in this Section that are listed and labeled.

1. The terms Listed and Labeled as defined in the National Electrical Code, Article

100.

2. Listing and Labeling Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.

3. Comply with National Electrical Manufacturer's Association NEMA FU-1 Low Voltage Cartridge Fuses.

4. Comply with IEC269.

5. Comply with CANENA Standard 248.

6. Comply with UL 198.

1.6. EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Spare Fuses: Furnish quantity equal to 20 percent of each 600 ampere and smaller fuse type and size installed, but not less than one (1) set of three (3) of each type and size. (Provide three (3) of each 601 Ampere and larger fuse type and size installed.)

2. Fuse Pullers: Furnish two (2) fuse pullers.

PART 2. PRODUCTS

2.1. MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fuses that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Industries Inc. Bussmann Div.

2. Eagle Electric Mfg, Co. Inc.

3. General Electric Co; Wiring Devices Div.

4. Mersen (formerly Ferraz Shawmut)

5. Tracor, Inc; Littelfuse, Inc. Subsidiary

B. All fuses shall be of the same manufacturer to assure coordination.

2.2. CARTRIDGE FUSES

A. Characteristics: NEMA FU-1, nonrenewable cartridge fuse; class as specified or indicated; current rating as indicated; voltage rating consistent with circuit voltage.

B. Fuses shall feature a solid state visual open fuse indicator, metal-embossed date and catalog

number for identification.

PART 3. EXECUTION

3.1. EXAMINATION

A. Examine utilization equipment nameplates and installation instructions to verify proper fuse locations, sizes, and characteristics.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2. FUSE APPLICATIONS

A. Motor Branch Circuits: Class RK1, time delay, 250 Volt Class J, Time Delay 600 Volt, 0-600 Amp, and 300 kA interrupting rating. Time delay fuses shall hold 500% of rated current for a minimum of 10 seconds.

1. The following guidelines apply for motors protected by properly sized overload relays:

   a. Fuses for motors with a marked service factor not less than 1.15 shall be installed in ratings of 125% of motor full-load current (or next size larger if 125 percent does not correspond to a fuse size), except where high ambient temperatures prevail, or where the motor drives a heavy revolving part which cannot be brought up to full speed quickly, such as large fans. Under such conditions, the fuses may be 150 percent to 175 percent of the motor full-load current.
   b. For all other motors, (such as 1.0 service factor motors) fuses shall be sized in ratings of 115 percent of the motor full load current (or next size larger if 115 percent does not correspond to a fuse size) except as noted above.

2. The following guidelines apply where fuses are used as the only overload protection for the motor:

   a. For motors with a 1.15 service factor or more, fuses should be sized at 125 percent of motor full-load current (or next size smaller if 125 percent does not correspond to a fuse size).
   b. For all other motors, fuses should be sized at 115 percent of motor full-load current (or next size smaller, if 115 percent does not correspond to a fuse size.

3. Fuse sizes for motor protection shall be chosen from fuse manufacturers published data and recommendations.

B. Other Branch Circuits: Class RK1, non time delay, 250 Volt, Class J Time Delay 600 Volt, 0-600 Amp, and 300 kA interrupting rating.

C. Control Circuits: Class CC, current limiting rejection type, rated 0-30 amperes, 600 volts, and 200- kA interrupting rating.

D. Provide fuses of type and rating recommended by equipment manufacturer for packaged

and/or specialized equipment.

E. Six hundred ampere or less, installed ahead of breaker: Class RK1, time delay.

F. Motor Controllers: NEMA and IEC Style motor controllers shall be protected from short-circuits by Dual-Element Time-Delay fuses in order to provide testing agency-witnessed Type 2 coordination for the controller. This provides “no damage” protection for the controller, under low and high level fault conditions, as required by IEC Publication 947-4. For IEC style controller, the fuses shall be installed in ratings to coordinate with the overload relays, such that the relay/fuse curves cross over at 7-10 times the IEC contactor current rating.

3.3. INSTALLATION

A. Fuses shall not be installed until equipment is ready to be energized. This measure prevents fuse damage during shipment of the equipment from the manufacturer to the job site, or from water that may contact the fuse before the equipment is installed. Final tests and inspections shall be made prior to energizing the equipment. This shall include a thorough cleaning, tightening, and review of all electrical connections and inspection of all grounding conductors. All fuses shall be furnished and installed by the electrical contractor. All fuses shall be of the same manufacturer.

B. Install fuses in fusible devices as indicated. Arrange fuses so fuse ratings and open fuse indicator are visible without removing fuse.

C. Provide fuse clips as required.

END OF SECTION

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ENCLOSED CONTROLLERS
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SECTION 26 29 13
ENCLOSED 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. This Section includes AC motor-control devices rated 600 V and less that are supplied as enclosed units.

B. Related Sections include the following:

1. Division 26 Section 26 05 00 “Common Work Results for Electrical” for Mechanical - Electrical coordination requirements.

2. Division 26 Section 26 05 00 “Common Work Results for Electrical” for general materials and installation methods.

3. Division 26 Section 26 05 53 “Identification for Electrical Systems” for labeling materials.

4. Division 26 Section 26 28 13 “Fuses” for fuses in combination motor controllers with feasible switches.

1.3. DEFINITIONS

A. N.C.: Normally closed.

B. N.O.: Normally open.

C. OCPD: Overcurrent protective device.

1.4. SUBMITTALS

A. Product Data: For products specified in this Section. Include dimensions, ratings, and data on features and components.

B. Maintenance Data: For products to include in the operation and maintenance manuals specified in Division 01.

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. Submit a schedule of equipment to indicate motor controller ratings, sizes, and other electrical characteristics for each item of equipment.

1.5. QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain, within 50 miles (80 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Source Limitations: Obtain similar motor-control devices through one source from a single manufacturer.

C. Comply with NFPA 70.

D. Listing and Labeling: Provide motor controllers specified in this Section that are listed and labeled.

1. The Terms Listed and Labeled: As defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A Nationally Recognized Testing Laboratory as defined in OSHA Regulation 1910.7.

E. UL Compliance: NEMA ICS 2, Industrial Control Devices, Controllers and Assemblies.

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 (minus 30 deg C) and not exceeding 104 deg F (40 deg C).

2. Altitude: Not exceeding 6600 feet (2010 m).

B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by Owner or other unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner no fewer than two 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 Owner’s written

permission.

4. Comply with NFPA 70E.

1.8. COORDINATION

A. Coordinate features of controllers and accessory devices with pilot devices and control circuits to which they connect.

B. Coordinate features, accessories, and functions of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, and the duty cycle of the motor and load.

C. The horsepower rating of all starters shall be checked against actual motor to be controlled, before installation and correct size overload elements shall be provided in all starters based on nameplate and manufacturer's recommendation.

D. Provide all control devices and wiring, where not provided under Division 23, required for all equipment.

E. Motors and controllers shall be provided for voltage and current characteristics as indicated. In the event that equipment provided is of different electrical characteristics than the ones specified, any increase in electrical feeders, conduits, circuit breakers, etc., including increase of labor cost shall be the responsibility of the Contractor.

F. Provide branch circuits for all motors to the starting equipment and then to the motors, complete with all control wiring for automatic and remote control where required or noted. Conduits to motors shall terminate in the conduit fittings on the motors, the final connection being made with flexible metal conduit (FMC) in dry locations and with Liquid-Tight Flexible Metal Conduit (LFMC) in damp/wet locations.

G. All conduits and wiring required for control work from the holding coil circuit of the starter, including the furnishing and installation of control devices such as auxiliary contacts, control relays, time delay relays, pilot lights, selector switches, alternators, etc., shall be provided and installed by other trades unless otherwise indicated.

H. Power Branch Circuits: Wire sizes for branch circuits not specifically called for on drawings or in Specifications shall be based on 125 percent of the full load current of the motor unless the voltage drop of motor branch circuits exceeds 1-1/2 percent from the distribution panel to the motor; in which case, voltage drop shall govern wire sizes. A power factor of 80 percent shall be used for motors in such calculations.

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. Overload Relays: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

2. Pilot Lights: Equal to 10 percent of quantity installed for each type, but no fewer

than two of each type. Where lamps are field replaceable, furnish spare lamps only.

PART 2. PRODUCTS

2.1. MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, supply equipment from one of the following manufacturers. No other manufacturers are acceptable.

1. Square D Company; Groupe Schneider. (Basis of Design).

2. Eaton Corporation; Westinghouse & Cutler-Hammer Products.

3. Siemens Energy and Automation, Inc.

4. Allen-Bradley Company; Industrial Control Group.

5. Crouse-Hinds ECM; Cooper Industries, Inc. Division.

6. General Electric (GE).

B. All motor controllers shall be NEMA type controllers. IEC type controllers shall NOT be acceptable.

2.2. COMBINATION MAGNETIC MOTOR CONTROLLERS

A. Description: Combine magnetic motor controllers with fusible switch disconnect in common enclosure.

1. Magnetic Motor Controllers: NEMA ICS 2, AC general-purpose Class A full-voltage, non-reversing, across-the-line magnetic controller for induction motors rated in horsepower.

2. Fusible Switch Assemblies: NEMA KS 1, enclosed knife switch with externally operable handle and visible blades. Switch shall have a color-coded externally operated handle. Operating handle shall give positive visual indication of "on/off" with red and black color-coding. Switch shall have fuse clips to accept rejection-type, dual-element, current-limiting, time-delay fuses, as specified in Division 26 Section 26 28 13 "Fuses".

B. Control Circuit: Coordinate with Automatic Temperature Control Contractor; obtained from integral control power transformer.

C. Coil: Encapsulated type.

D. Poles: As indicated.

E. Size: NEMA size 1, unless otherwise indicated.

F. Contacts: Totally enclosed, double-break, silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring.

G. Wiring: Straight-through wiring with all terminals clearly marked.

H. Overload Relay: NEMA ICS. Provide with sensors in each phase matched to nameplate full-load current of specific motor to which they connect, and with appropriate adjustment for motor duty cycle.

1. Solid State: Trip current rating will be established by selection of overload relay and shall be adjustable (3 to 1 current range). The overload shall be self-powered, provide phase loss and phase unbalance protection, have a permanent tamper guard, and be ambient insensitive. It shall be available in Trip Class 10 or Class 20 and have a mechanical test function.

2. Outputs: Provide normally closed (N.C.) auxiliary contact.

3. Reset: Unit shall offer both manual reset and remote reset using an external module.

I. Options and Features:

1. Control Power Transformers: Include a control power transformer with adequate capacity to operate connected pilot light, indicating and control devices. Provide fused secondary protection and bond un-fused leg of secondary to enclosure.

2. Auxiliary Contacts: Provide two normally open (N.O.) and two normally closed (N.C.) auxiliary contacts in each starter in addition to the standard normally open (N.O.) sealing contact.

3. Selector Switches: Rotary type, Hand-Off-Automatic (H-O-A) selector switch.

4. Cover Mounted Indicating Lights: Green "Power Available" and red "Running" LED type indicating lights. "Power Available" indicating light shall be connected at the load side of the fused secondary terminals of the control power transformer. "Running" indicating light shall be connected through one normally open (N.O.) auxiliary control contact. Indicating lights connected to the start button or across the load side of starters will not be acceptable. Indicating lights shall be equipped with individual legend plates supplied by the manufacturer.

5. Pilot Device Contacts: NEMA ICS 2, Form "Z".

J. Enclosures: Enclosures shall comply with requirements of NSMA 250 – “Enclosures for Electrical Equipment” and NSMA ICS 6 – “Enclosures Standard; and the following requirements to meet environmental conditions:

1. Dry interior locations: NEMA Type 1

2. Damp/wet outdoor locations: NEMA Type 4X, Type 304 stainless steel.

K. Furnish Square D, Class 8538 Type S, or approved equal.

PART 3. EXECUTION

3.1. APPLICATIONS

A. Select features of each motor controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

C. Use fractional-horsepower manual motor controllers for single-phase motors, unless otherwise indicated.

D. Hand-Off-Automatic Selector Switches: In covers of motor controllers started and stopped by automatic controls or interlocked with other equipment.

E. Provide fuses and solid state overload relays correlated with full load nameplate current of motors provided. Set adjustable overload devices to suit motor nameplate.

3.2. INSTALLATION

A. Install motor controllers in locations as indicated, according to manufacturer's written instructions.

B. Install motor controllers level and plumb. Provide mounting brackets, wall bracing, and accessories as required.

C. Install motor controllers to have adequate working space in accordance with Article 110.26 of the National Electrical Code. Motor controllers shall not be installed beneath ductwork, piping, etc.

D. Install independently mounted motor-control devices according to manufacturer's written instructions.

E. Location: Locate controllers within sight of motors controlled, unless otherwise indicated.

F. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks conforming to Division 26 Section 26 05 29 “Hangers and Supports for Electrical Systems”.

3.3. IDENTIFICATION

A. Identify motor-control components and control wiring according to requirements specified in Division 26 Section 26 05 53 “Identification for Electrical Systems”.

B. All motor controllers shall be provided with engraved nameplates which clearly identify the equipment served, circuit designation, and circuit voltage/phase.

3.4. CONTROL WIRING INSTALLATION

A. Install wiring between motor-control devices according to Division 26 Section 26 05 19 “Low Voltage Electrical Power Conductors and Cables”.

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic control devices where available.

3.5. CONNECTIONS

A. Connect motor controllers and components to wiring system and to ground as indicated and instructed by manufacturer.

B. Tighten connectors, terminals, bus joints, and mountings. Tighten field-connected connectors and terminals, including screws and bolts, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.6. FIELD QUALITY CONTROL

A. Visual and Mechanical Inspection: Include the following inspections and related work.

1. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with drawings and schedules.

2. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer’s instructions.

3. Check tightness of electrical connections of devices with calibrated torque wrench. Use Manufacturer’s recommended torque values.

4. Clean devices using Manufacturer’s approved methods and materials.

5. Verify proper fuse types and ratings in fusible devices.

6. Verify that fuses are facing out and that fuse ratings are readable without removing fuses.

7. Verify proper overload types and ratings in devices with overload protection.

8. Verify proper operation of pilot lights.

9. Verify proper operation of hand-off-automatic selector switches.

10. Motor-Control Device Ratings and Settings: Verify that ratings and settings as installed are appropriate for final loads and final system arrangement and parameters. Recommend final protective-device ratings and settings where differences are found. Use accepted revised ratings or settings to make the final system adjustments. Prepare and submit the load current and overload relay heater list.

3.7. CLEANING

A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally, using methods and materials recommended by manufacturer.

END OF SECTION

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