

STATE OF DELAWARE
DIVISION OF FACILITIES MANAGEMENT
CONTRACT # MC0213000002

SPECIFICATIONS
FOR

**JP COURT 3/17 LOBBY
RENOVATIONS
AND ADDITIONS
AND PARKING LOT
EXPANSION**

THIS COPY IS
FOR
INFORMATION
ONLY. YOU
MUST
PURCHASE THE
PROPOSAL TO
SUBMIT A BID.

23730 SHORTLY RD.
GEORGETOWN, DE

PREPARED
BY

**DELAWARE ARCHITECTS, LLC
550 S. DUPONT BLVD., SUITE E
MILFORD, DELAWARE 19963**

September 2012

ADVERTISEMENT FOR BIDS

Sealed bids for **OMB/DFM Contract No. MC0213000002 – J.P. Court 3/17 – Lobby Renovation and Addition and Parking Lot Expansion** will be received by the State of Delaware, Office of Management and Budget, Division of Facilities Management, in the reception area of the Facilities Management Office in the Thomas Collins Building, 540 S. DuPont Highway, Suite 1 (Third Floor), Dover, DE 19901 until 2:00 p.m. local time on Wednesday, February 6, 2013, 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 the following at J.P. Court 3/17 located in Georgetown, Delaware: construction of a frame addition to the front of the existing building. Work includes selective demolition, as required, to tie the addition in to the existing building, construction of the addition, interior finishes and mechanical, plumbing and electrical work as may be required for the addition. Also included is all work related to the expansion of the existing parking lot including site work, storm water pond, paving, landscaping and striping. The project base bid includes the existing building unused by the owner during construction. There is an alternate for phasing construction to allow the facility to remain in use during construction.

Attention is called to construction schedule as detailed in the Bid Documents.

A **MANDATORY** Pre-Bid Meeting will be held on Tuesday, January 22, 2013, at 3:00 p.m. in the J.P. Court 3/17 lobby, 23730 Shortly Road, Georgetown, Delaware, for the purpose of establishing the list 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 the Division of Facilities Management, 540 S. DuPont Highway, Suite 1, Dover, DE 19901, Attn: Kerry Wareham. The outer envelope should clearly indicate: **"OMB/DFM CONTRACT NO. MC0213000002 – J.P. COURT 3/17 – LOBBY RENOVATION AND ADDITION AND PARKING LOT EXPANSION - SEALED BID - DO NOT OPEN."**

Contract documents may be obtained at the office of Delaware Architects, LLC, 550 S. DuPont Boulevard, Suite E, Milford, DE 1993, phone (302) 491-8047, upon receipt of \$50.00 per CD/non-refundable. Checks are to be made payable to "Delaware Architects, LLC".

Construction documents will be available for review at the following locations: Delaware Architects, LLC; Delaware Contractors Association; Associated Builders and Contractors.

Minority Business Enterprises (MBE), Disadvantaged Business Enterprises (DBE) and Women-Owned Business Enterprises (WBE) will be afforded full opportunity to submit bids on this contract and will not be subject to discrimination on the basis of race, color, national origin or sex in consideration of this award. 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.

END OF ADVERTISEMENT FOR BIDS

reject any or all bids and to waive any informality 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.

CANNOT BE USED FOR BIDDING

TABLE OF CONTENTS**DIVISION 00 – PROCUREMENT AND CONTRACT REQUIREMENTS**

SECTION 00 01 01 – PROJECT TITLE PAGE
 SECTION 00 01 10 – TABLE OF CONTENTS
 SECTION 00 01 15 – LIST OF DRAWING SHEETS
 SECTION 00 11 16 – INVITATION TO BID
 SECTION 00 21 13 – INSTRUCTIONS TO BIDDERS
 SECTION 00 41 13 – BID FORM
 SECTION 00 41 13 - NOT USED
 SECTION 00 43 13 – BID BOND
 SECTION 00 52 13 – STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR
 SECTION 00 52 13 - SAMPLE AIA A101
 SECTION 00 54 13 – SUPPLEMENT TO AGREEMENT BETWEEN OWNER & CONTRACTOR A101-2007
 SECTION 00 61 13 – PERFORMANCE BOND
 SECTION 00 61 13 – PAYMENT BOND
 SECTION 00 62 76 – APPLICATION AND CERTIFICATE FOR PAYMENT FORMS SAMPLE G702-G703 1992
 SECTION 00 72 13 – GENERAL CONDITIONS TO THE CONTRACT
 SECTION 00 72 13 - SAMPLE AIA A201
 SECTION 00 73 13 – SUPPLEMENTARY GENERAL CONDITIONS
 SECTION 00 73 46 – WAGE RATE REQUIREMENTS
 SECTION 00 81 13 – GENERAL REQUIREMENTS

DIVISION 01

SECTION 01 10 00 – SUMMARY OF WORK
 SECTION 01 22 00 - UNIT PRICES
 SECTION 01 23 00 – ALTERNATES
 SECTION 01 24 00 – NOT USED
 SECTION 01 26 00 – CONTRACT MODIFICATION PROCEDURES
 SECTION 01 29 00 – PAYMENT PROCEDURES
 SECTION 01 31 00 – PROJECT MANAGEMENT AND COORDINATION
 SECTION 01 32 00 – CONSTRUCTION PROGRESS DOCUMENTATION
 SECTION 01 32 33 – PHOTOGRAPHIC DOCUMENTATION
 SECTION 01 33 00 – SUBMITTAL PROCEDURES
 SECTION 01 40 00 – QUALITY REQUIREMENTS
 SECTION 01 42 00 – REFERENCES
 SECTION 01 50 00 – TEMPORARY FACILITIES AND CONTROLS
 SECTION 01 60 00 – PRODUCT REQUIREMENTS
 SECTION 01 73 00 – EXECUTION
 SECTION 01 73 29 – CUTTING AND PATCHING
 SECTION 01 74 19 – CONSTRUCTION WASTE MANAGEMENT
 SECTION 01 77 00 – CLOSEOUT PROCEDURES
 SECTION 01 78 39 – PROJECT RECORD DOCUMENTS

DIVISION 02

SECTION 024119 – SELECTIVE DEMOLITION

DIVISION 03

SECTION 033000 – CAST IN PLACE CONCRETE

DIVISION 4

SECTION 042200 – CONCRETE UNIT MASONRY
SECTION 042113 – BRICK MASONRY

DIVISION 5

NOT USED

DIVISION 06

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY
SECTION 061600 - SHEATHING
SECTION 061753 - SHOP FABRICATED WOOD TRUSSES
SECTION 064600 – WOOD TRIM

DIVISION 07

SECTION 071933 - WATER REPELLENTS
SECTION 072100 – THERMAL INSULATION
SECTION 073113 – ASPHALT SHINGLES
SECTION 074600 - SIDING
SECTION 075419 - PVC ROOFING
SECTION 077100 - ROOF SPECIALTIES
SECTION 079200 – JOINT SEALANTS

DIVISION 08

SECTION 081113 – STEEL DOORS AND FRAMES
SECTION 081416 - FLUSH WOOD DOORS
SECTION 084113 – ALUMINUM STOREFRONTS
SECTION 085113 - ALUMINUM WINDOWS
SECTION 087100 – DOOR HARDWARE
SECTION 088000 – GLAZING

DIVISION 09

SECTION 092900 – GYPSUM BOARD
SECTION 095123 – ACOUSTICAL CEILINGS
SECTION 096513 – RESILIENT BASE AND ACCESSORIES
SECTION 096519 - VINYL COMPOSITE TILE
SECTION 096813 - TILE CARPETING
SECTION 099113 - EXTERIOR PAINTING
SECTION 099123 – INTERIOR PAINTING

DIVISION 10

SECTION 104413 – FIRE EXTINGUISHER CABINETS
SECTION 104416 – FIRE EXTINGUISHERS

DIVISION 22

SECTION 220500 – COMMON WORK RESULTS FOR PLUMBING

DIVISION 23

SECTION 230500 – COMMON WORK RESULTS FOR HVAC
SECTION 230210 – BASIC MATERIALS AND METHODS – HVAC
SECTION 230505 - HVAC PIPING, FITTINGS, VALVES
SECTION 230548 - VIBRATION CONTROLS FOR HVAC
SECTION 230593 - TESTING, ADJUSTING AND BALANCING

SECTION 230701 - HVAC INSULATION

SECTION 230900 - AUTOMATIC TEMPERATURE CONTROLS
SECTION 238126 - VARIABLE SPLIT SYSTEMS

DIVISION 26

SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL
SECTION 260519 - CONDUCTORS AND CABLES
SECTION 260526 - GROUNDING AND BONDING
SECTION 260528 - ELECTRICAL FIRESTOPPING
SECTION 260529 - HANGERS AND SUPPORTS
SECTION 260533 - RACEWAYS AND BOXES
SECTION 260533 - SURFACE METAL RACEWAY
SECTION 260553 - ELECTRICAL IDENTIFICATION
SECTION 260923 - LIGHTING CONTROL DEVICES
SECTION 262416 – PANEL BOARDS
SECTION 262726 - WIRING DEVICES
SECTION 262813 - FUSES
SECTION 262816 - ENCLOSED SWITCHES & CIRCUIT BREAKERS
SECTION 262913 - MOTOR CONTROLLERS
SECTION 265100 - INTERIOR LIGHTING
SECTION 265600 – EXTERIOR LIGHTING

DEL DOT DIVISION 200

DIVISION 200 - EARTHWORK
DIVISION 202 – EXCAVATION AND EMBANKMENT
DIVISION 207 – EXCAVATION AND BACKFILLING FOR STRUCTURES
DIVISION 208 – EXCAVATION AND BACKFILLING FOR PIPE TRENCHES
DIVISION 209 – BORROW
DIVISION 210 – FURNISH BORROW FOR PIPE TRENCH AND STRUCTURE BACKFILLING
DIVISION 212 – UNDERCUT EXCAVATION
DIVISION 250 – SEDIMENT REMOVAL
DIVISION 251 – SILT FENCE
DIVISION 252 – INLET SEDIMENT CONTROL
DIVISION 254 – STONE CHECK DAM
DIVISION 257 – RIP RAP DITCH
DIVISION 264 - DEWATERING BASIN
DIVISION 271 - STORMWATER MANAGEMENT POND
DIVISION 272 – POND OUTLET STRUCTURE, CONCRETE

DEL DOT DIVISION 300

DIVISION 301 – SELECT BORROW BASE COURSE
DIVISION 302 - GRADED AGGREGATE BASE COURSE
DIVISION 304 – ASPHALT STABILIZED BASE COURSE
DIVISION 305 – GRADED AGGREGATE FOR TEMPORARY ROADWAY MATERIAL

DEL DOT DIVISION 400

DIVISION 401 – HOT MIX LAID BITUMINOUS CONCRETE PAVEMENT
DIVISION 402 – HOT MIX BITUMINOUS CONCRETE AND COLD LAID BITUMINOUS
CONCRETE FOR TEMPORARY ROADWAY MATERIAL
DIVISION 403 – PLANT MIX OPEN GRADED WEARING SURFACE
DIVISION 404 - BITUMINOUS SURFACE TREATMENT
DIVISION 405 – BITUMINOUS SURFACE RETREATMENT
DIVISION 406 – HOT MIX PATCHING

DEL DOT DIVISION 600

DIVISION 602 – CONCRETE STRUCTURES
DIVISION 612 – REINFORCED CONCRETE PIPE
DIVISION 614 – CORRUGATED PIPE
DIVISION 617 – FLARED END SECTION

DEL DOT DIVISION 700

DIVISION 701 - CURB AND INTEGRAL CURB AND GUTTER
DIVISION 705 - PORTLAND CEMENT CONCRETE SIDEWALK
DIVISION 708 - DRAINAGE INLETS AND MANHOLES
DIVISION 710 - ADJUSTING AND REPAIRING DRAINAGE INLETS AND MANHOLES
DIVISION 712 – RIP RAP
DIVISION 713 – GEOTEXTILES
DIVISION 714 – DITCHING
DIVISION 732 – TOPSOIL
DIVISION 733 – TOPSOILING
DIVISION 734 – SEEDING
DIVISION 735 – MULCHING
DIVISION 736 – SODDING
DIVISION 748 – PAVEMENT MARKINGS
DIVISION 760 - PAVEMENT MILLING
DIVISION 762 – SAW CUTTING PORTLAND CEMENT AND HOT MIX, HOTLAID
BITUMINOUS CONCRETE

DEL DOT DIVISION 800

DIVISION 803 – WATER FOR MIXING PORTLAND CEMENT CONCRETE
DIVISION 804 – FINE AGGREGATE
DIVISION 805 – COARSE AGGREGATE
DIVISION 810 – ASPHALT CEMENT
DIVISION 812 – PORTLAND CEMENT CONCRETE
DIVISION 813 – GRADING REQUIREMENTS MINIMUM AND MAXIMUM PERCENTAGES
DIVISION 823 – HOT MIX, HOT LAID BITUMINOUS CONCRETE

END OF SECTION

LIST OF DRAWING SHEETS

G1.0 COVER SHEET

ARCHITECTURAL

A1.1 DEMOLITION PLAN
 A1.2 FLOOR PLAN
 A1.3 ROOF PLAN
 A1.4 REFLECTED CEILING PLAN
 A2.1 ELEVATIONS
 A3.1 SECTIONS
 A5.1 DETAILS
 A6.1 SCHEDULES
 A6.2 STOREFRONT ELEVATIONS AND DETAILS

STRUCTURAL

S0.1 STRUCTURAL NOTES
 S0.2 SPECIAL INSPECTION NOTES
 S1.1 FOUNDATION PLAN
 S1.2 ROOF FRAMING PLAN
 S2.1 TYPICAL SECTIONS & DETAILS

MECHANICAL

MD1.1 FIRST FLOOR PLAN HVAC DEMOLITION
 M1.1 FIRST FLOOR PLAN HVAC NEW WORK
 M3.1 DETAILS HVAC
 M4.1 SCHEDULES HVAC

PLUMBING

PD1.1 FIRST FLOOR PLAN PLUMBING DEMOLITION
 P1.1 FIRST FLOOR PLAN PLUMBING NEW WORK

ELECTRICAL

EPD1.1 FIRST FLOOR PLAN POWER DEMOLITION
 ELD1.1 FIRST FLOOR PLAN LIGHTING DEMOLITION
 ED4.1 SCHEDULES ELECTRICAL DEMO
 EP1.1 FIRST FLOOR PLAN POWER NEW WORK
 EL1.1 FIRST FLOOR PLAN LIGHTING NEW WORK
 E3.1 DETAILS ELECTRICAL
 E3.2 DETAILS ELECTRICAL
 E4.1 SCHEDULES ELECTRICAL NEW WORK
 E6.1 SITE PLAN ELECTRICAL NEW WORK

CIVIL

1 COVER
 2 EXISTING CONDITIONS PLAN
 3 PROPOSED SITE PLAN
 4 PROPOSED STORMWATER AND GRADING PLAN
 5 EROSION AND SEDIMENT CONTROL PLAN
 6 E&S DETAILS
 7 DETAILS
 8 PROPOSED LANDSCAPE PLAN

INSTRUCTIONS TO BIDDERS

TABLE OF ARTICLES

1. DEFINITIONS
2. BIDDER'S REPRESENTATION
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.

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 valid Delaware Business License Number with their Bid or shall state that the process of application for a Delaware Business License has been initiated.

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.
- 3.2.3 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.
- 3.4 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.

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

4.5 PREVAILING WAGE REQUIREMENT

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

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

4.5.3 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.

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

4.5.5 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 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. 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 and Bond, 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) or a Delaware business license number, and should the vendor be awarded a contract, such vendor shall provide to the agency the taxpayer identification or Delaware business 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. Prior to execution of the resulting contract, the successful Bidder shall be required to produce proof of its Delaware business license if not provided in its bid.
- 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, that 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.

END OF INSTRUCTIONS TO BIDDERS

**JP COURT 3& 17 LOBBY
RENOVATIONS AND ADDITIONS &
PARKING LOT EXPANSION
23730 SHORTLY RD., GEORGETOWN, DE
PROJECT No. MC0213000002**

BID FORM

For Bids Due: _____ (DATE) **To:** _____ (OWNER)

Name of Bidder: _____

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

(Other License Nos.): _____

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

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

Lobby Renovations And Additions
\$ _____
(\$ _____)

Parking Lot Expansion
\$ _____
(\$ _____)

ALTERNATES

Alternate prices conform to applicable project specification section. Refer to specifications 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: Additional construction required for phasing of the project per plans and specifications.
Add/Deduct: _____
(\$ _____) Additional time in construction days _____

ALTERNATE No. 2: Tie new HVAC controls into existing energy management system.
Add/Deduct: _____
(\$ _____)

**JP COURT 3& 17 LOBBY
RENOVATIONS AND ADDITIONS &
PARKING LOT EXPANSION
23730 SHORTLY RD., GEORGETOWN, DE
PROJECT No. MC0213000002**

UNIT PRICES

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

UNIT PRICE No. 1: Satisfactory fill in place per cubic yard. \$ _____

UNIT PRICE No. 2: Stone in place per cubic yard. Contract \$ _____

UNIT PRICE No. 3: Undercut and disposal (mass) per cubic yard. \$ _____

UNIT PRICE No. 4: Stone (trench) backfill per cubic yard. \$ _____

UNIT PRICE No. 5: Topsoil per cubic yard. \$ _____

BID FORM

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 _____ days from the date of opening of bids, and the undersigned shall abide by the Bid Security forfeiture provisions. Bid Security is attached to this Bid.

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: _____

**JP COURT 3& 17 LOBBY
RENOVATIONS AND ADDITIONS &
PARKING LOT EXPANSION
23730 SHORTLY RD., GEORGETOWN, DE
PROJECT No. MC0213000002**

Witness: _____ By: _____
(Authorized Signature)

(SEAL) _____
(Title)

Date: _____

ATTACHMENTS

- Sub-Contractor List
- Non-Collusion Statement
- Bid Security
- (Others as Required by Project Manuals)

BID FORM

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.**

<u>Subcontractor Category</u>	<u>Subcontractor</u>	<u>Address (City & State)</u>
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____
7.	_____	_____
8.	_____	_____
9.	_____	_____

**JP COURT 3& 17 LOBBY
RENOVATIONS AND ADDITIONS &
PARKING LOT EXPANSION
23730 SHORTLY RD., GEORGETOWN, DE
PROJECT No. MC0213000002**

BID FORM

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: _____

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.

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:

Title

STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR A101-2007

The contract to be utilized on this project shall be the “Standard Form of Agreement Between Owner and Contractor” AIA Document A101-2007.

CANNOT BE USED FOR BIDDING

DRAFT AIA® Document A101™ - 2007

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

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

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

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

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

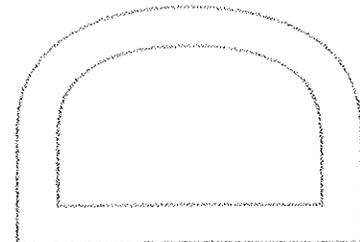
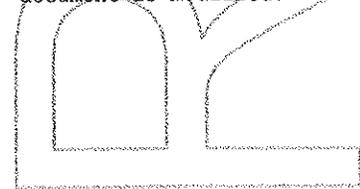
The Architect:
(Name, legal status, address and other information)

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.

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

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



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

« »

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

« »

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

§ 3.3 The Contractor shall achieve Substantial Completion of the entire Work not later than « » (« ») days from the date of commencement, or as follows:

(Insert number of calendar days. Alternatively, a calendar date may be used when coordinated with the date of commencement. If appropriate, insert requirements for earlier Substantial Completion of certain portions of the Work.)

« »

Portion of Work

Substantial Completion Date

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

« »

ARTICLE 4 CONTRACT SUM

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

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

« »

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

Item	Units and Limitations	Price Per Unit (\$0.00)
------	-----------------------	-------------------------

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

Item	Price
------	-------

ARTICLE 5 PAYMENTS

§ 5.1 PROGRESS PAYMENTS

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

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

« »

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

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form and supported

by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment.

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

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

- .1 Take that portion of the Contract Sum properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the Contract Sum allocated to that portion of the Work in the schedule of values, less retainage of percent (%). Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute shall be included as provided in Section 7.3.9 of AIA Document A201™-2007, General Conditions of the Contract for Construction;
- .2 Add that portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing), less retainage of percent (%);
- .3 Subtract the aggregate of previous payments made by the Owner; and
- .4 Subtract amounts, if any, for which the Architect has withheld or nullified a Certificate for Payment as provided in Section 9.5 of AIA Document A201-2007.

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

- .1 Add, upon Substantial Completion of the Work, a sum sufficient to increase the total payments to the full amount of the Contract Sum, less such amounts as the Architect shall determine for incomplete Work, retainage applicable to such work and unsettled claims; and
(Section 9.8.5 of AIA Document A201-2007 requires release of applicable retainage upon Substantial Completion of Work with consent of surety, if any.)
- .2 Add, if final completion of the Work is thereafter materially delayed through no fault of the Contractor, any additional amounts payable in accordance with Section 9.10.3 of AIA Document A201-2007.

§ 5.1.8 Reduction or limitation of retainage, if any, shall be as follows:

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

«»

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

§ 5.2 FINAL PAYMENT

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

- .1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Section 12.2.2 of AIA Document A201-2007, and to satisfy other requirements, if any, which extend beyond final payment; and
- .2 a final Certificate for Payment has been issued by the Architect.

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

«»

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 INITIAL DECISION MAKER

The Architect will serve as Initial Decision Maker pursuant to Section 15.2 of AIA Document A201-2007, unless the parties appoint below another individual, not a party to this Agreement, to serve as Initial Decision Maker.

(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

« »
« »
« »
« »

§ 6.2 BINDING DISPUTE RESOLUTION

For any Claim subject to, but not resolved by, mediation pursuant to Section 15.3 of AIA Document A201-2007, the method of binding dispute resolution shall be as follows:

(Check the appropriate box. If the Owner and Contractor do not select a method of binding dispute resolution below, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.)

Arbitration pursuant to Section 15.4 of AIA Document A201-2007

Litigation in a court of competent jurisdiction

Other *(Specify)*

« »

ARTICLE 7 TERMINATION OR SUSPENSION

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

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

ARTICLE 8 MISCELLANEOUS PROVISIONS

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

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

(Insert rate of interest agreed upon, if any.)

« » % « »

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

« »
« »
« »
« »
« »
« »
« »

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

« »
« »
« »
« »
« »
« »
« »

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

§ 8.6 Other provisions:

« »

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

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

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

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

§ 9.1.3 The Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

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

« »

Section	Title	Date	Pages

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

« »

Number	Title	Date

§ 9.1.6 The Addenda, if any:

Number	Date	Pages

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

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

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



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



ARTICLE 10 INSURANCE AND BONDS

The Contractor shall purchase and maintain insurance and provide bonds as set forth in Article 11 of AIA Document A201-2007.

(State bonding requirements, if any, and limits of liability for insurance required in Article 11 of AIA Document A201-2007.)

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

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

OWNER (Signature)

«»«»«»

(Printed name and title)

CONTRACTOR (Signature)

«»«»«»

(Printed name and title)

SUPPLEMENT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR A101-2007

The following supplements modify the “Standard Form of Agreement Between Owner and Contractor,” AIA Document A101-2007. 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 Architect 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

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

PERFORMANCE BOND

Bond Number: _____

KNOW ALL PERSONS BY THESE PRESENTS, that we, _____, as principal (“**Principal**”), and _____, a _____ corporation, legally authorized to do business in the State of Delaware, as surety (“**Surety**”), are held and firmly bound unto the _____ (“**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: _____

Name:

(Corporate Seal)

By: _____ (SEAL)

Name:

Title:

SURETY

Name: _____

Witness or Attest: Address: _____

Name:

(Corporate Seal)

By: _____ (SEAL)

Name:

Title:

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

PAYMENT BOND

Bond Number: _____

KNOW ALL PERSONS BY THESE PRESENTS, that we, _____, as principal (“**Principal**”), and _____, a _____ corporation, legally authorized to do business in the State of Delaware, as surety (“**Surety**”), are held and firmly bound unto the _____ (“**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: _____

Name:

(Corporate Seal)

By: _____ (SEAL)

Name:

Title:

SURETY

Name: _____

Witness or Attest: Address: _____

Name:

(Corporate Seal)

By: _____ (SEAL)

Name:

Title:

AIA® Document G702™ - 1992

Application and Certificate for Payment

TO OWNER: PROJECT: DVMC - Bear APPLICATION NO: 001 Distribution to: OWNER: ARCHITECT: CONTRACTOR: FIELD:

PERIOD TO: General Construction CONTRACT FOR: CONTRACT DATE: PROJECT NOS:

FROM CONTRACTOR: VIA ARCHITECT:

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

- 6. TOTAL EARNED LESS RETAINAGE..... \$0.00
(Line 4 Less Line 5 Total)
- 7. LESS PREVIOUS CERTIFICATES FOR PAYMENT..... \$0.00
(Line 6 from prior Certificate)
- 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: _____ 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: _____ Date: _____

By: _____ 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.

AIA Document G702™ - 1992. Copyright © 1993, 1963, 1965, 1978 and 1992 by The American Institute of Architects. All rights reserved. WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This draft was produced by AIA software at 10:28:39 on 02/26/2010 under Order No. 0371896314_1 which expires on 05/19/2010, and is not for resale. User Notes: (1383483201)

AIA® Document G703™ - 1992

Continuation Sheet

AIA Document G702, APPLICATION AND CERTIFICATION FOR PAYMENT, 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.

A ITEM NO.	B DESCRIPTION OF WORK	C SCHEDULED VALUE	D WORK COMPLETED		E THIS PERIOD	F MATERIALS PRESENTLY STORED (NOT IN D OR E)	G TOTAL COMPLETED AND STORED TO DATE (D + E + F)	H BALANCE TO FINISH (C - G)	I 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
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		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
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		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
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		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
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		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
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		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
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		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

GENERAL CONDITIONS

TO THE

CONTRACT

The General Conditions of this Contract are as stated in the American Institute of Architects Document AIA A201 (2007 Edition) entitled General Conditions of the Contract for Construction and is part of this project manual as if herein written in full.

SUPPLEMENTARY GENERAL CONDITIONS A201-2007

The following supplements modify the “General Conditions of the Contract for Construction,” AIA Document A201-2007. 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

1. GENERAL PROVISIONS
2. OWNER
3. CONTRACTOR
4. ADMINISTRATION OF THE CONTRACT
5. SUBCONTRACTORS
6. CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
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
14. TERMINATION OR SUSPENSION OF THE CONTRACT

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:

1.1.2 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.

1.5 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 five (5) 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.

3.11 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.

3.17 In the first 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.

10.5 Delete Paragraphs 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

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.

END OF SUPPLEMENTARY GENERAL CONDITIONS

CANNOT BE USED FOR BIDDING

STATE OF DELAWARE
DEPARTMENT OF LABOR
DIVISION OF INDUSTRIAL AFFAIRS
OFFICE OF LABOR LAW ENFORCEMENT
PHONE: (302) 451-3423

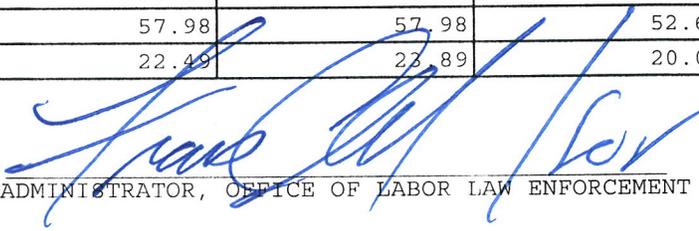
Mailing Address:
225 CORPORATE BOULEVARD
SUITE 104
NEWARK, DE 19702

Located at:
225 CORPORATE BOULEVARD
SUITE 104
NEWARK, DE 19702

PREVAILING WAGES FOR BUILDING CONSTRUCTION EFFECTIVE MARCH 15, 2012

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
ASBESTOS WORKERS	23.22	29.83	39.20
BOILERMAKERS	65.47	33.22	48.83
BRICKLAYERS	45.63	45.63	45.63
CARPENTERS	49.06	49.06	39.22
CEMENT FINISHERS	40.38	29.11	21.20
ELECTRICAL LINE WORKERS	43.49	37.29	28.44
ELECTRICIANS	59.10	59.10	59.10
ELEVATOR CONSTRUCTORS	73.14	40.93	30.55
GLAZIERS	62.60	62.60	54.20
INSULATORS	50.38	50.38	50.38
IRON WORKERS	58.70	58.70	58.70
LABORERS	37.20	37.20	37.20
MILLWRIGHTS	60.85	60.85	47.42
PAINTERS	40.62	40.62	40.62
PILEDRIVERS	66.42	37.64	30.45
PLASTERERS	21.61	21.61	17.50
PLUMBERS/PIPEFITTERS/STEAMFITTERS	57.95	43.24	46.28
POWER EQUIPMENT OPERATORS	55.81	55.81	24.13
ROOFERS-COMPOSITION	21.01	20.71	17.02
ROOFERS-SHINGLE/SLATE/TILE	17.59	17.50	16.45
SHEET METAL WORKERS	64.39	62.18	62.18
SOFT FLOOR LAYERS	44.92	44.92	44.92
SPRINKLER FITTERS	50.65	50.65	50.65
TERRAZZO/MARBLE/TILE FNRS	50.50	50.50	45.45
TERRAZZO/MARBLE/TILE STRS	57.98	57.98	52.63
TRUCK DRIVERS	22.49	23.89	20.03

CERTIFIED: 12/26/12

BY: 
ADMINISTRATOR, OFFICE OF LABOR LAW ENFORCEMENT

NOTE: THESE RATES ARE PROMULGATED AND ENFORCED PURSUANT TO THE PREVAILING WAGE REGULATIONS ADOPTED BY THE DEPARTMENT OF LABOR ON APRIL 3, 1992.

CLASSIFICATIONS OF WORKERS ARE DETERMINED BY THE DEPARTMENT OF LABOR. FOR ASSISTANCE IN CLASSIFYING WORKERS, OR FOR A COPY OF THE REGULATIONS OR CLASSIFICATIONS, PHONE (302) 451-3423.

NON-REGISTERED APPRENTICES MUST BE PAID THE MECHANIC'S RATE.

PROJECT: MC0213000002 AOC JP Court 3/17 Lobby Renovations and Additions, Sussex County

STATE OF DELAWARE
DEPARTMENT OF LABOR
DIVISION OF INDUSTRIAL AFFAIRS
OFFICE OF LABOR LAW ENFORCEMENT
PHONE: (302) 451-3423

Mailing Address:
225 CORPORATE BOULEVARD
SUITE 104
NEWARK, DE 19702

Located at:
225 CORPORATE BOULEVARD
SUITE 104
NEWARK, DE 19702

PREVAILING WAGES FOR HIGHWAY CONSTRUCTION EFFECTIVE MARCH 15, 2012

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
BRICKLAYERS	45.63	45.63	14.51
CARPENTERS	49.06	49.06	39.22
CEMENT FINISHERS	30.40	26.13	23.29
ELECTRICAL LINE WORKERS	22.50	54.05	21.25
ELECTRICIANS	59.10	59.10	59.10
IRON WORKERS	42.20	22.98	25.35
LABORERS	30.23	26.66	29.03
MILLWRIGHTS	16.11	15.63	13.49
PAINTERS	56.07	56.07	56.07
PILEDRIVERS	59.23	23.75	26.95
POWER EQUIPMENT OPERATORS	41.41	27.54	26.43
SHEET METAL WORKERS	22.75	20.31	18.40
TRUCK DRIVERS	32.17	22.45	22.15

CERTIFIED:

5/25/12

BY:

[Signature]
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.

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NON-REGISTERED APPRENTICES MUST BE PAID THE MECHANIC'S RATE.

PROJECT: MC0213000002 JP Court 3-17 Parking Lot Expansion, Sussex County

GENERAL REQUIREMENTS

TABLE OF ARTICLES

1. GENERAL PROVISIONS
2. OWNER
3. CONTRACTOR
4. ADMINISTRATION OF THE CONTRACT
5. SUBCONTRACTORS
6. CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
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
14. TERMINATION OR SUSPENSION OF THE CONTRACT

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, color, sex or national origin. The Contractor will take positive steps to ensure that applicants are employed and that employees are treated during employment without regard to their race, creed, color, sex 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, color, sex 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.

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 pursuing 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.

5.2 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 direct salary plus customary fringe benefits (prevailing wage rates) and documented statutory costs such as workman's compensation insurance, Social

Security/Medicare, and unemployment insurance (a maximum multiplier of 1.35 times DPE).

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, but still requires small items of miscellaneous work, the Owner 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 \$1,000,000 \$1,000,000	for each person for each occurrence aggregate
Property Damage	\$500,000 \$1,000,000	for each occurrence aggregate

11.7.2 Contractor's Protective Liability Insurance

Minimum coverage to be:

Bodily Injury	\$500,000 \$1,000,000	for each person for each occurrence
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	\$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 Delaware Archaeological Board 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 in the State Museum.

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

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
1. Work covered by the Contract Documents.
 2. Work phases.
 3. Work under other contracts.
 4. Use of premises.
 5. Owner's occupancy requirements.
 6. Specification formats and conventions.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: “ JP COURT 3/17 LOBBY – RENOVATIONS AND ADDITIONS & PARKING LOT EXPANSION, PROJECT No. MC0213000002”
1. Project Location: “23730 Shortly Rd., Georgetown, DE”
- B. Owner: State of Delaware, Division of Facilities Management
- C. Owner's Representative: Mark Devore
- D. Architect: Delaware Architects, LLC, 550 S. DuPont Blvd., Suite E, Milford, Delaware 19963.
- E. The Work consists of the following:
1. The Work includes the construction of a frame addition to the front of the existing JP Court 3/17. Work includes selective demolition as required to tie the addition into the existing building, the construction of the addition, interior finishes and Mechanical, Plumbing and electrical work as may be required for the addition. Also included is all work related to the expansion of the existing parking lot including sitework, stormwater ponds, paving, landscaping and striping. The project base bid includes the existing building unused by the owner during construction. There is an alternate for phasing construction to allow the facility to remain in use during construction.
- F. Project will be constructed under a single prime contract.

1.3 USE OF PREMISES

- A. General: Contractor shall have limited use of premises for construction operations as directed by the Owner.
- B. Use of Site: Limit use of premises 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 constructions operations to those areas as indicated on the drawings.
 - 2. Owner Occupancy: Allow for Owner occupancy of Project site and use by the public.
 - 3. Maintain access to existing walkways, drives, parking areas, and other adjacent site amenities as well as occupied or used buildings and facilities. Do not close or obstruct walkways, or other occupied buildings or used facilities without written permission from Owner.
 - 4. 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.

1.4 OPERATIONS AND STORAGE AREAS

- A. Coordination of Work with the Owner's Representative to cause the least possible interference with building activities,
- B. The Contractor shall confine all operations (including storage of materials) on to areas authorized or approved by the Owner's Representative. The Contractor shall hold and save the Department of Corrections and the State of Delaware, its officers and agents, free and harmless from liability of any nature resulting from the Contractor's performance and/or negligence. It is understood that the Department of Corrections and the State of Delaware shall not be held responsible for any damage to the Contractor's equipment, materials, supplies or the like which may result from vandalism, theft etc. while on site.
- C. The Contractor shall, under regulations prescribed by the Owner's Representative, use only established roadways.
- D. When materials are transported in performance of work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.
- E. The Owner's Representative shall designate working space and space available for storing materials. Unless otherwise indicated on drawings as the Contractor's "Staging Area", all working and storage space must be approved by the Owner's Representative prior to its use.
- F. Contract personnel are subject to the State of Delaware rules of conduct
- G. Contractor shall execute work in such a manner as to interfere as little as possible with work being done by others. Keep roads clear of construction materials, debris, standing construction

equipment and vehicles at all times. Materials and Equipment shall not be stored in other than assigned areas.

1.5 WORK RESTRICTIONS

- A. Base bid work schedule shall be 7:00 am – 4:00 pm M-F. If the phasing alternate is accepted, the work schedule shall be 3:00 pm – 11:00 pm.
- B. State Holidays: No construction related work will be allowed on State Holidays.

1.6 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 33-division format and CSI/CSC's "MasterFormat" numbering system.
 - 1. Division 01: Sections in Division 01 govern the execution of the Work of all Sections in the Specifications.
- B. 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. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
 - 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
 - a. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for unit prices.
- B. See Division 01 Section "Allowances" for procedures for using unit prices to adjust quantity allowances.

1.2 DEFINITIONS

- A. Unit price is a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

1.3 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A list of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 LIST OF UNIT PRICES

- A. See Bid Form

END OF SECTION 012200

CANNOT BE USED FOR BIDDING

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for alternates.

1.2 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. 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.

1.3 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. See applicable Specification Sections 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 No. : required additional construction and additional time required for phasing the project allowing the owner use of the facility during construction including a revised work schedule of 3:00 pm to 11:00 pm M-F.
- B. Alternate No. 2: Tie new HVAC systems into existing energy management system.

END OF SECTION 012300

CANNOT BE USED FOR BIDDING

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

- A. Architect 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."

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect 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 Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request 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 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 Architect.

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 "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

C. Proposal Request Form: Use AIA Document G709 for Proposal Requests.

1.4 ALLOWANCES

- A. Allowances are not considered as part of this contract.

1.5 CHANGE ORDER PROCEDURES

- A. A Change Order that results in added cost to the project must be approved by Owner/Architect..
- B. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. 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 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 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 Application for Payment forms with Continuation Sheets Submittals Schedule and Contractor's Construction Schedule.
 - 2. Submit the Schedule of Values to Architect at earliest possible date but no later than 15 days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Sub-schedules: Where the Work is separated into phases requiring separately phased payments, provide sub-schedules 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 Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Submit draft of AIA Document G703 Continuation Sheets.
 - 3. 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.
 - 4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 - 5. 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.
 - 6. 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.
 - 7. 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.
8. 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.

1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect 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: Progress payments shall be submitted to Architect by the last day of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
- 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. Architect 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. Transmittal: Submit 5 signed and notarized original copies of each Application for Payment to Architect 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.
- F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
 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 final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

- G. 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. Schedule of unit prices.
 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.
- H. Application for Payment at Substantial Completion: 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.
- I. Final Payment Application: 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 meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 9. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Coordination Drawings.
 - 2. Project meetings.
 - 3. Requests for Interpretation (RFIs).
- B. See Division 01 Section "Multiple Contract Summary" for a description of the division of Work among separate contracts and responsibility for coordination activities not in this Section.
- C. See Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.2 DEFINITIONS

- A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.3 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 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.
- B. 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.

- C. 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.
 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. Preinstallation conferences.
 7. Project closeout activities.

1.4 SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
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 architectural, structural, civil, mechanical, and electrical systems.
 - b. 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 Architect 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 but no larger than 30 by 40 inches.
 3. Number of Copies: Submit five opaque copies of each submittal. Architect will return one copy.
 4. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

1.5 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 Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Architect will record significant discussions and agreements achieved. Architect will distribute the meeting minutes to everyone concerned, including Owner and Contractor, within five days of the meeting.

- B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. 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. Procedures for processing field decisions and Change Orders.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. LEED requirements.
 - l. Preparation of Record Documents.
 - m. Use of the premises.
 - n. Work restrictions.
 - o. Owner's occupancy requirements.
 - p. Responsibility for temporary facilities and controls.
 - q. Construction waste management and recycling.
 - r. Parking availability.
 - s. Office, work, and storage areas.
 - t. Equipment deliveries and priorities.
 - u. First aid.
 - v. Security.
 - w. Progress cleaning.
 - x. Working hours.
 3. Minutes: Architect will record and distribute meeting minutes to everyone concerned, including Owner and Contractor.
- 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 Architect 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. The 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 parties who should have been present.
 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. Progress Meetings: Conduct progress meetings at biweekly intervals. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of Owner and Architect, 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 conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. 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) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) RFIs.
 - 16) Status of proposal requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.
3. Minutes: Architect will record and distribute meeting minutes to everyone concerned, including Owner and Contractor.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
 - 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.

1.6 REPORTING REQUIREMENTS

- A. The Contractor is required to check-in with the Owner's Representative on a weekly basis (or as otherwise agreed upon). The Contractor will provide the Owner's Representative with an anticipated work schedule, and the Owner's Representative will furnish the Contractor with a schedule of conflicting times and dates if applicable. This weekly check-in is mandatory and may not be accomplished by telephone or e-mail.

1.7 REQUESTS FOR INTERPRETATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.

1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned 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 interpretation and the following:
1. Project name.
 2. Date.
 3. Name of Contractor.
 4. Name of Architect.
 5. RFI number, numbered sequentially.
 6. Specification Section number and title and related paragraphs, as appropriate.
 7. Drawing number and detail references, as appropriate.
 8. Field dimensions and conditions, as appropriate.
 9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 10. Contractor's signature.
 11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
- C. Hard-Copy RFIs: CSI Form 13.2A.
1. Identify each page of attachments with the RFI number and sequential page number.
- D. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow seven working days for Architect's response for each RFI. RFIs received 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 Architect's actions on submittals.
 - f. Incomplete RFIs or RFIs with numerous errors.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
 3. Architect'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 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

- E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect 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. Include the following:
 - 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Architect.
 - 4. RFI number including RFIs that were dropped and not submitted.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Architect's response was received.
 - 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
1. Contractor's Construction Schedule.
 2. Submittals Schedule.
 3. Daily construction reports.
 4. Monthly Progress reports.
 5. Field condition reports.
- B. See Division 01 Section "Payment Procedures" for submitting the Schedule of Values.
- C. See Division 01 Section "Photographic Documentation" for submitting construction photographs.

1.2 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. 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.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Float: The measure of leeway in starting and completing an activity.
1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
- E. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

- F. Major Area: A story of construction, a separate building, or a similar significant construction element.

1.3 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 Architect's final release or approval.
- B. Preliminary Network Diagram: Submit two opaque copies, large enough to show entire network for entire construction period. Show logic ties for activities.
- C. Contractor's Construction Schedule: Submit two opaque copies of initial 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 weekly intervals.
- E. Monthly Construction Progress Report: Submit three copies along with Request for Payment.
- F. Field Condition Reports: Submit two copies at time of discovery of differing conditions.

1.4 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 Construction Schedule 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 Construction Schedule.
 2. Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final 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.
- B. 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 20 days, unless specifically allowed by Architect.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
 4. Startup and Testing Time: Include the appropriate number of days for startup and testing.
 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
- C. 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.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.
- 2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)
- A. Bar Graph Schedule: Submit a comprehensive, fully developed, horizontal Bar Graph, Contractor's Construction Schedule within 10 days of date established for the Notice of Award. Base schedule on the Preliminary Construction Schedule and whatever updating and feedback was received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
- 1. For construction activities that require 3 months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.
- 2.4 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. Equipment at Project site.
 - 3. Material deliveries.
 - 4. High and low temperatures and general weather conditions.
 - 5. Accidents.
 - 6. Stoppages, delays, shortages, and losses.
 - 7. Orders and requests of authorities having jurisdiction.
 - 8. Services connected and disconnected.
- B. Monthly Construction Progress Reports: Prepare a monthly construction report to be submitted along with requests for payment. Three copies of the Monthly Construction Progress Reports shall be submitted to the Architect. The Architect will distribute report to Owner and VCGS.

Monthly Construction Progress Reports shall record the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. Equipment at Project site.
3. Material deliveries.
4. High and low temperatures and general weather conditions.
5. Accidents.
6. Stoppages, delays, shortages, and losses.
7. Orders and requests of authorities having jurisdiction.
8. Services connected and disconnected.

- 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. 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 Architect 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 if applicable.
 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 013200

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
- B. See Division 01 Section "Closeout Procedures" for submitting digital media as Project Record Documents at Project closeout.
- C. See Division 01 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.

1.2 SUBMITTALS

- A. Key Plan: Submit key plan of Project Site with notation of vantage points marked for location and direction of each photograph. Indicate location (Section and Field) of construction. Include same label information as corresponding set of photographs.
- B. Construction Photographs: Submit one file of each photographic view within seven days of taking photographs.
 - 1. Format: Digital. Keep all photographic images on a CD disc on site for review.
 - 2. Identification: In a corresponding log, provide the following information keyed to each photo file:
 - a. Name of Project.
 - b. Name of Architect.
 - c. Name of Contractor.
 - d. Date and time of day photograph was taken if not date stamped by camera.
 - e. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - f. Unique sequential identifier.
 - 3. Digital Images: Submit a complete set of digital image electronic files as a Project Record Document on CD-ROM. Identify electronic media with date photographs were taken. Submit images that have same aspect ratio as the sensor, uncropped.

1.3 COORDINATION

- A. Auxiliary Services: Cooperate with photographer and provide auxiliary services requested, including access to Project site and use of temporary facilities, including temporary lighting required to produce clear, well-lit photographs without obscuring shadows.

1.4 USAGE RIGHTS

- A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in uncompressed TIFF format, produced by a digital camera with minimum sensor size of 4.0 megapixels, and at an image resolution of not less than 1024 by 768 pixels.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
 - 1. Date and Time: Include date and time in filename for each image.
 - 2. Field Office Images: Maintain one set of images on CD-ROM in the field office at Project site, available at all times for reference. Identify images same as for those submitted to Architect.
- C. Preconstruction Photographs: Before starting construction, take, digital photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
 - 1. Flag excavation areas and construction limits before taking construction photographs.
 - 2. Take a minimum of eight photographs to show existing conditions adjacent to property before starting the Work.
 - 3. Take a minimum of eight photographs of adjoining fields to accurately record physical conditions at start of construction.
- D. Periodic Construction Photographs: Take 12, digital photographs bi-weekly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken. Photographs must accompany each monthly request for payment.
- E. Additional Photographs: Architect may issue requests for additional photographs, in addition to periodic photographs specified.

1. Three days' notice will be given, where feasible.
2. In emergency situations, take additional photographs within 24 hours of request.
3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Special events planned at Project site.
 - b. Immediate follow-up when on-site events result in construction damage or losses.
 - c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
 - d. Substantial Completion of a major phase or component of the Work.
 - e. Extra record photographs at time of final acceptance.
 - f. Owner's request for special publicity photographs.

END OF SECTION 013233

CANNOT BE USED FOR BIDDING

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. See Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule.
- C. See Division 01 Section "Photographic Documentation" for submitting construction photographs.
- D. See Division 01 Section "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
- E. See Division 01 Section "Closeout Procedures" for submitting warranties.
- F. See Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's responsive action.
- B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL PROCEDURES

- A. 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. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- B. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

- C. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect'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. Architect 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.
- D. 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 Architect.
 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - 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., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.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.
- E. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
- F. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
1. Additional copies submitted for maintenance manuals will be marked with action taken and will be returned.
- G. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor.

1. Transmittal Form: Use AIA Document G810 or CSI Form 12.1A.
- H. 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"
- I. 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.
- J. Use for Construction: Use only final submittals with mark indicating " Approved or Approved as noted " taken by Architect.
- 1.4 CONTRACTOR'S USE OF ARCHITECT'S CAD FILES
- A. General: At Contractor's written request, copies of Architect's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
1. Contractor must provide Delaware Architects, LLC (DALLC) with an executed release of liability form as provide by DALLC.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
- 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. Manufacturer's catalog cuts.
 - e. Wiring diagrams showing factory-installed wiring.
 - f. Printed performance curves.
 - g. Operational range diagrams.
 - h. Compliance with specified referenced standards.
 - i. Testing by recognized testing agency.

4. Number of Copies: Submit three copies of Product Data, unless otherwise indicated. Architect will return two copies. 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.
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. Notation of coordination requirements.
 - j. Notation of dimensions established by field measurement.
 - k. Relationship to adjoining construction clearly indicated.
 - l. Seal and signature of professional engineer if specified.
 - m. 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 but no larger than 30 by 40 inches.
 3. Number of Copies: Submit two opaque (bond) copies of each submittal. Architect will return one copy.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of appropriate Specification Section.
 3. 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.
 4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

- a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
- E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location.
 1. Number of Copies: Submit three copies of product schedule or list, unless otherwise indicated. Architect will return two copies.
 - F. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
 - G. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
 - H. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
 - I. 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.
 1. Number of Copies: Submit three copies of subcontractor list, unless otherwise indicated. Architect will return two copies.
- ## 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. Architect 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 "Quality Requirements."

- B. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- F. Installer Certificates: Prepare 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.
- G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- J. Material Test Reports: Prepare 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.
- K. Product Test Reports: Prepare 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.
- L. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.
- M. 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.
- N. Compatibility Test Reports: Prepare 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.

- O. 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.
- P. 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 "Operation and Maintenance Data."
- Q. Design Data: Prepare 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.
- R. 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.
- S. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
 - 1. Statement on condition of substrates and their acceptability for installation of product.
 - 2. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
- T. 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.
- U. Construction Photographs: Comply with requirements specified in Division 01 Section "Photographic Documentation."
- V. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Architect.
 - 1. Architect will not review submittals that include MSDSs and will return them for resubmittal.

2.3 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

- B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

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 Architect.
- 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 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
 - 1. "Approved" or "Approved as noted" indicates "Fabrication/Installation may be undertaken. Approval does not authorize changes to the Contract Sum or Contract Time" Nor does it relieve the contractor from their responsibility for review and verification that submittal meets the requirements set forth in the construction documents.
 - 2. "Revise and Resubmit" or "Rejected" indicates "Fabrication and/or installation MAY NOT be undertaken. In resubmitting, limit corrections to items marked.
 - 3. Review/approval neither extends nor alters any contractual obligations of the Architect/Engineer or Contractor.
- C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect 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.

3.3 REQUIRED SUBMISSIONS

- A. Contractor to submit product literature/samples for approval of the following:

1. Concrete Mix Design
2. Concrete Masonry Units
3. Cold Formed metal Framing and Accessories
4. Interior Architectural Woodwork
5. Thermal Insulation
6. Sealants
7. Hollow Metal Frames
8. Wood Doors
9. Aluminum Assemblies
10. Door Hardware
11. Windows
12. Glazing
13. Acoustical Ceilings
14. Resilient Base and Accessories
15. Resilient Flooring
16. Paint
17. Fire extinguishers and Cabinets
18. HVAC ??

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This 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. 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.
 - 2. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. See Divisions 02 through 33 Sections for specific test and inspection requirements.

1.2 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 Architect.
- C. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.
- D. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- E. 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 industry standards.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Sub-contractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades people of the corresponding generic name.
- J. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

- A. General: 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 uncertainties and requirements that are different, but apparently equal, to Architect 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 Architect for a decision before proceeding.

1.4 SUBMITTALS

- A. Qualification Data: 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.
- B. Reports: Prepare and submit certified written reports that 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 reinspecting.
- C. 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.

1.5 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. 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.
- C. 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.
- D. 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.
- 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. 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 548; 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.
- G. 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.

- H. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Sections in Divisions 02 through 49.

1.6 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. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. 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.
 - 1. 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.
 - 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 - 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 - 5. 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 "Submittal Procedures."
- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Architect 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.
- F. 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.
- G. 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.

1.7 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Conducted by a qualified testing agency or special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 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. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
- 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 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

AA	Aluminum Association, Inc. (The)
AAADM	American Association of Automatic Door Manufacturers
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists (The)
ABAA	Air Barrier Association of America
ABMA	American Bearing Manufacturers Association
ACI	ACI International (American Concrete Institute)
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies, Inc. (The)
AF&PA	American Forest & Paper Association
AGA	American Gas Association
AGC	Associated General Contractors of America (The)
AHA	American Hardboard Association (Now part of CPA)
AHAM	Association of Home Appliance Manufacturers
AI	Asphalt Institute

AIA	American Institute of Architects (The)
AISC	American Institute of Steel Construction
AIISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALCA	Associated Landscape Contractors of America (Now PLANET - Professional Landcare Network)
ALSC	American Lumber Standard Committee, Incorporated
AMCA	Air Movement and Control Association International, Inc.
ANSI	American National Standards Institute
AOSA	Association of Official Seed Analysts, Inc.
APA	Architectural Precast Association
APA	APA - The Engineered Wood Association
APA EWS	APA - The Engineered Wood Association; Engineered Wood Systems
API	American Petroleum Institute
ARI	Air-Conditioning & Refrigeration Institute
ARMA	Asphalt Roofing Manufacturers Association
ASCE	American Society of Civil Engineers
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	ASME International (The American Society of Mechanical Engineers International)
ASSE	American Society of Sanitary Engineering
ASTM	ASTM International (American Society for Testing and Materials International)
AWCI	AWCI International (Association of the Wall and Ceiling Industry International)
AWCMA	American Window Covering Manufacturers Association

(Now WCSC)

AWI	Architectural Woodwork Institute
AWPA	American Wood-Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association (The)
BICSI	BICSI
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International)
BISSC	Baking Industry Sanitation Standards Committee
CCC	Carpet Cushion Council
CDA	Copper Development Association
CEA	Canadian Electricity Association
CFFA	Chemical Fabrics & Film Association, Inc.
CGA	Compressed Gas Association
CIMA	Cellulose Insulation Manufacturers Association
CISCA	Ceilings & Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CRRC	Cool Roof Rating Council
CPA	Composite Panel Association
CPPA	Corrugated Polyethylene Pipe Association
CRI	Carpet & Rug Institute (The)
CRSI	Concrete Reinforcing Steel Institute
CSA	Canadian Standards Association

CSA	CSA International (Formerly: IAS - International Approval Services)
CSI	Cast Stone Institute
CSI	Construction Specifications Institute (The)
CSSB	Cedar Shake & Shingle Bureau
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute)
DHI	Door and Hardware Institute
EIA	Electronic Industries Alliance
EIMA	EIFS Industry Members Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ESD	ESD Association
FIBA	Federation Internationale de Basketball (The International Basketball Federation)
FIVB	Federation Internationale de Volleyball (The International Volleyball Federation)
FM Approvals	FM Approvals
FM Global	FM Global (Formerly: FMG - FM Global)
FMRC	Factory Mutual Research (Now FM Global)
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.
FSA	Fluid Sealing Association
FSC	Forest Stewardship Council
GA	Gypsum Association
GANA	Glass Association of North America
GRI	(Now GSI)
GS	Green Seal

GSI	Geosynthetic Institute
HI	Hydraulic Institute
HI	Hydronics Institute
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)
HPVA	Hardwood Plywood & Veneer Association
HPW	H. P. White Laboratory, Inc.
IAS	International Approval Services (Now CSA International)
IBF	International Badminton Federation
ICEA	Insulated Cable Engineers Association, Inc.
ICRI	International Concrete Repair Institute, Inc.
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The)
IESNA	Illuminating Engineering Society of North America
IEST	Institute of Environmental Sciences and Technology
IGCC	Insulating Glass Certification Council
IGMA	Insulating Glass Manufacturers Alliance
ILI	Indiana Limestone Institute of America, Inc.
ISO	International Organization for Standardization
ISSFA	International Solid Surface Fabricators Association
ITS	Intertek Testing Service NA
ITU	International Telecommunication Union
KCMA	Kitchen Cabinet Manufacturers Association
LMA	Laminating Materials Association (Now part of CPA)
LPI	Lightning Protection Institute

MBMA	Metal Building Manufacturers Association
MFMA	Maple Flooring Manufacturers Association, Inc.
MFMA	Metal Framing Manufacturers Association, Inc.
MH	Material Handling (Now MHIA)
MHIA	Material Handling Industry of America
MIA	Marble Institute of America
MPI	Master Painters Institute
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
NAAMM	National Association of Architectural Metal Manufacturers
NACE	NACE International (National Association of Corrosion Engineers International)
NADCA	National Air Duct Cleaners Association
NAGWS	National Association for Girls and Women in Sport
NAIMA	North American Insulation Manufacturers Association
NBGQA	National Building Granite Quarries Association, Inc.
NCAA	National Collegiate Athletic Association (The)
NCMA	National Concrete Masonry Association
NCPI	National Clay Pipe Institute
NCTA	National Cable & Telecommunications Association
NEBB	National Environmental Balancing Bureau
NECA	National Electrical Contractors Association
NeLMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NETA	InterNational Electrical Testing Association
NFHS	National Federation of State High School Associations

NFPA	NFPA (National Fire Protection Association)
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NLGA	National Lumber Grades Authority
NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association)
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	NSF International (National Sanitation Foundation International)
NSSGA	National Stone, Sand & Gravel Association
NTMA	National Terrazzo & Mosaic Association, Inc. (The)
NTRMA	National Tile Roofing Manufacturers Association (Now TRI)
NWWDA	National Wood Window and Door Association (Now WDMA)
OPL	Omega Point Laboratories, Inc. (Now ITS)
PCI	Precast/Prestressed Concrete Institute
PDCA	Painting & Decorating Contractors of America
PDI	Plumbing & Drainage Institute
PGI	PVC Geomembrane Institute
PLANET	Professional Landcare Network (Formerly: ACLA - Associated Landscape Contractors of America)
PTI	Post-Tensioning Institute
RCSC	Research Council on Structural Connections
RFCI	Resilient Floor Covering Institute

RIS	Redwood Inspection Service
SAE	SAE International
SDI	Steel Deck Institute
SDI	Steel Door Institute
SEFA	Scientific Equipment and Furniture Association
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)
SGCC	Safety Glazing Certification Council
SIA	Security Industry Association
SIGMA	Sealed Insulating Glass Manufacturers Association (Now IGMA)
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SMPTE	Society of Motion Picture and Television Engineers
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division)
SPIB	Southern Pine Inspection Bureau (The)
SPRI	Single Ply Roofing Industry
SSINA	Specialty Steel Industry of North America
SSPC	SSPC: The Society for Protective Coatings
STI	Steel Tank Institute
SWI	Steel Window Institute
SWRI	Sealant, Waterproofing, & Restoration Institute
TCA	Tile Council of America, Inc.
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
TMS	The Masonry Society

TPI	Truss Plate Institute, Inc.
TPI	Turfgrass Producers International
TRI	Tile Roofing Institute
UL	Underwriters Laboratories Inc.
UNI	Uni-Bell PVC Pipe Association
USAV	USA Volleyball
USGBC	U.S. Green Building Council
USITT	United States Institute for Theatre Technology, Inc.
WASTEC	Waste Equipment Technology Association
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association (Now WCSC)
WCSC	Window Covering Safety Council (Formerly: WCMA - Window Covering Manufacturers Association)
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association)
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California)
WIC	Woodwork Institute of California (Now WI)
WMMPA	Wood Moulding & Millwork Producers Association
WSRCA	Western States Roofing Contractors Association
WWPA	Western Wood Products Association

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

BOCA	BOCA International, Inc. (See ICC)
IAPMO	International Association of Plumbing and Mechanical Officials
ICBO	International Conference of Building Officials

(See ICC)

ICBO ES ICBO Evaluation Service, Inc.
(See ICC-ES)

ICC International Code Council

ICC-ES ICC Evaluation Service, Inc.

SBCCI Southern Building Code Congress International, Inc.
(See ICC)

UBC Uniform Building Code
(See ICC)

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

CE Army Corps of Engineers

CPSC Consumer Product Safety Commission

DOC Department of Commerce

DOD Department of Defense

DOE Department of Energy

EPA Environmental Protection Agency

FAA Federal Aviation Administration

FCC Federal Communications Commission

FDA Food and Drug Administration

GSA General Services Administration

HUD Department of Housing and Urban Development

LBL Lawrence Berkeley National Laboratory

NCHRP National Cooperative Highway Research Program
(See TRB)

NIST National Institute of Standards and Technology

OSHA Occupational Safety & Health Administration

PBS Public Building Service

(See GSA)

PHS	Office of Public Health and Science
RUS	Rural Utilities Service (See USDA)
SD	State Department
TRB	Transportation Research Board
USDA	Department of Agriculture
USPS	Postal Service

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list.

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA)
CFR	Code of Federal Regulations
DOD	Department of Defense Military Specifications and Standards
DSCC	Defense Supply Center Columbus (See FS)
FED-STD	Federal Standard (See FS)
FS	Federal Specification
FTMS	Federal Test Method Standard (See FS)
MIL	(See MILSPEC)
MIL-STD	(See MILSPEC)
MILSPEC	Military Specification and Standards
UFAS	Uniform Federal Accessibility Standards

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

CBHF State of California, Department of Consumer Affairs Bureau of Home Furnishings and Thermal Insulation

CCR California Code of Regulations

CPUC California Public Utilities Commission

TFS Texas Forest Service
Forest Resource Development

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

CANNOT BE USED FOR BIDDING

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. See Division 01 Section "Execution" for progress cleaning requirements.
- C. See Divisions 02 through 33 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.
- D. See Division 31 Section "Dewatering" for disposal of ground water at Project site.

1.2 USE CHARGES

- A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.
- B. Water Service: Water from Owner's existing water system is available for irrigation and construction use, without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service: 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.

1.3 SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.4 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.

1.5 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 MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.76-mm-) thick, galvanized steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top rails.
- B. Portable Chain-Link Fencing: Minimum 2-inch (50-mm), 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide concrete bases for supporting posts.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations. Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Owner and shall be built with labor and materials furnished by the Contractor without expense to the Owner. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its own expense upon completion of the work.
- C. Fence: Before work operations begin, Contractor shall provide a chain link fence, six feet in height and no more, around the staging area. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at maximum 15 inches. Bottom of fences shall extend to one inch above grade.

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.
- 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. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to private system indicated as directed by authorities having jurisdiction.
- C. 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.
- D. It is the responsibility of the Contractor to provide water for newly installed sod/seeded areas as part of this contract. The Contractor may utilize water provided by the Owner via an existing irrigation system (if available), or tanks/water trucks filled offsite as necessary to transport water to areas where needed in order to complete the work required by this contract. Any water that the Contractor obtains from the Owner will not need to be metered and will not be charged to Contractor.
 - 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.
- E. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- F. 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.
- G. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.
 - 1. Provide additional telephone lines for the following:

- a. Provide a dedicated telephone line for each facsimile machine and computer in each field office.
 2. At each telephone, post a list of important telephone numbers including police and fire departments Contractor's home office Architect's office Owner's office Principal subcontractors' field and home offices.
 3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
- H. Electronic Communication Service: Provide temporary electronic communication service, including electronic mail in field office.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines. Comply with NFPA 241.
2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Contractor shall utilize existing paved and gravel roads **only**. The construction of temporary roads, paths etc. shall **not** be permitted unless prior approval is granted by the Owner in writing.

C. 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.

D. Parking: Use designated areas as shown on drawings for parking areas for construction personnel.

E. 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.
2. Remove snow and ice as required to minimize accumulations.

F. Project Identification and Temporary Signs: Provide Project identification and other signs as indicated on Drawings. 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.

- 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 "Execution" for progress cleaning requirements.

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.
- B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
- C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- D. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.
- F. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
 - 1. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.
- H. 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.

4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

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, humidity control, ventilation, 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. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 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. See Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.
- C. See Divisions 02 through 33 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.2 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. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. 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 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.

1.3 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 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 architects 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. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Architect 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 Architect cannot make a decision on use of a proposed substitution within time allocated.
- B. 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. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect 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 "Submittal Procedures."
- b. Use product specified if Architect cannot make a decision on use of a comparable product request within time allocated.

- C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

1.4 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.

1.5 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.

1.6 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 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 Section "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," Architect will make selection.
 5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
 6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
- 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 Architect's sample. Architect'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, Architect 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, Architect 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: Architect 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 Architect.
- B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect 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 Architect 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.

2.3 COMPARABLE PRODUCTS

- A. Conditions: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect 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 architects and owners, if requested.
 5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 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. Progress cleaning.
 - 5. Starting and adjusting.
 - 6. Protection of installed construction.
 - 7. Correction of the Work.
- B. See Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.2 SUBMITTALS

- A. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.3 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.

PART 2 - PRODUCTS (Not Used)

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 points of connection of utility services.
- B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities 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; and underground electrical services.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. 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.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. 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 Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a licensed Professional Land Surveyor, registered in the State of Delaware, to lay out the Work using accepted surveying practices.
1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.

3. Inform installers of lines and levels to which they must comply.
 4. Check the location, level and plumb, of every major element as the Work progresses.
 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations. A registered professional land surveyor or registered civil engineer whose services are retained and paid for by the Contractor shall be used to restore any corner monuments that may be disturbed because of the Contractor's work performance.
- B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

3.5 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.
- 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 Architect.
 - 2. Allow for 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.

3.6 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.

2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- 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. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. 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.
- H. 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.
- I. 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.
- J. 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 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.

3.8 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "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.

END OF SECTION 017300

CANNOT BE USED FOR BIDDING

SECTION 017329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. See Divisions 2 through 33 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.2 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. Architect'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.

1.3 QUALITY ASSURANCE

- A. 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
- B. 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 Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

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.

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 and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
 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.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

SECTION 017419 CONSTRUCTION WASTE MANAGEMENT

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes: Administrative and procedural requirements for construction waste management activities.

1.2 DEFINITIONS

- A. Construction, Demolition, and Land clearing (CDL) Waste: Includes all non-hazardous solid wastes resulting from construction, remodeling, alterations, repair, demolition and land clearing. Includes material that is recycled, reused, salvaged or disposed as garbage.
- B. Salvage: Recovery of materials for on-site reuse, sale or donation to a third party.
- C. Reuse: Making use of a material without altering its form. Materials can be reused on-site or reused on other projects off-site. Examples include, but are not limited to the following: Crushing or grinding of concrete for use as sub-base material. Chipping of land clearing debris for use as mulch.
- D. Recycling: The process of sorting, cleaning, treating, and reconstituting materials for the purpose of using the material in the manufacture of a new product.
- E. Source-Separated CDL Recycling: The process of separating recyclable materials in separate containers as they are generated on the job-site. The separated materials are hauled directly to a recycling facility or transfer station.
- F. Co-mingled CDL Recycling: The process of collecting mixed recyclable materials in one container on-site. The container is taken to a material recovery facility where materials are separated for recycling.
- G. Approved Recycling Facility: Any of the following:
 - 1. A facility that can legally accept CDL waste materials for the purpose of processing the materials into an altered form for the manufacture of a new product.
 - 2. Material Recovery Facility: A general term used to describe a waste-sorting facility. Mechanical, hand-separation, or a combination of both procedures, are used to recover recyclable materials.

1.3 SUBMITTALS

- A. Contractor shall develop a Waste Management Plan: Submit 3 copies of plan within 14 days of date established for the **Notice to Proceed**.
- B. Contractor shall provide Waste Management Report: Concurrent with each Application for Payment, submit **3** copies of report.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Divert a minimum of **75%** CDL waste, by weight, from the landfill by one, or a combination of the following activities:
1. Salvage
 2. Reuse
 3. Source-Separated CDL Recycling
 4. Co-mingled CDL Recycling
- B. CDL waste materials that can be salvaged, reused or recycled include, but are not limited to, the following:
1. Acoustical ceiling tiles
 2. Asphalt
 3. Asphalt shingles
 4. Cardboard packaging
 5. Carpet and carpet pad
 6. Concrete
 7. Drywall
 8. Fluorescent lights and ballasts
 9. Land clearing debris (vegetation, stumpage, dirt)
 10. Metals
 11. Paint (through hazardous waste outlets)
 12. Wood
 13. Plastic film (sheeting, shrink wrap, packaging)
 14. Window glass
 15. Wood
 16. Field office waste, including office paper, aluminum cans, glass, plastic, and office cardboard.

1.5 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements, that employs a LEED Accredited Professional, certified by the USGBC as waste management coordinator.
- B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- C. Regulatory Requirements: Conduct construction waste management activities in accordance with hauling and disposal regulations of all authorities having jurisdiction and all other applicable laws and ordinances.
- D. Preconstruction Conference: Schedule and conduct meeting at Project site prior to construction activities.
1. Attendees: Inform the following individuals, whose presence is required, of date and time of meeting.

- a. Owner
 - b. Architect
 - c. Contractor's superintendent
 - d. Major subcontractors
 - e. Waste Management Coordinator
 - f. Other concerned parties.
2. Agenda Items: Review methods and procedures related to waste management including, but not limited to, the following:
 - a. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
 - b. Review requirements for documenting quantities of each type of waste and its disposition.
 - c. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - d. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - e. Review waste management requirements for each trade.
 3. Minutes: Record discussion. Distribute meeting minutes to all participants.
Note: If there is a Project Architect, they will perform this role.
- 1.6 WASTE MANAGEMENT PLAN – Contractor shall develop and document the following:
- A. Develop a plan to meet the requirements listed in this section at a minimum. Plan shall consist of waste identification, waste reduction plan and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight throughout the plan.
 - B. Indicate anticipated types and quantities of demolition, site-cleaning and construction waste generated by the project. List all assumptions made for the quantities estimates.
 - C. List each type of waste and whether it will be salvaged, recycled, or disposed of in a landfill. The plan should include the following information:
 1. Types and estimated quantities, by weight, of CDL waste expected to be generated during demolition and construction.
 2. Proposed methods for CDL waste salvage, reuse, recycling and disposal during demolition including, but not limited to, one or more of the following:
 - a. Contracting with a deconstruction specialist to salvage materials generated,
 - b. Selective salvage as part of demolition contractor's work,
 - c. Reuse of materials on-site or sale or donation to a third party.
 3. Proposed methods for salvage, reuse, recycling and disposal during construction including, but not limited to, one or more of the following:
 - a. Requiring subcontractors to take their CDL waste to a recycling facility;

- b. Contracting with a recycling hauler to haul recyclable CDL waste to an approved recycling or material recovery facility;
 - c. Processing and reusing materials on-site;
 - d. Self-hauling to a recycling or material recovery facility.
4. Name of recycling or material recovery facility receiving the CDL wastes.
 5. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on project site where materials separation will be located.
- D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:
1. Total quantity of waste.
 2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
 3. Total cost of disposal (with no waste management).
 4. Revenue from salvaged materials.
 5. Revenue from recycled materials.
 6. Savings in hauling and tipping fees by donating materials.
 7. Savings in hauling and tipping fees that are avoided.
 8. Handling and transportation costs. Including cost of collection containers for each type of waste.
 9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT, GENERAL

- A. Provide containers for CDL waste that is to be recycled clearly labeled as such with a list of acceptable and unacceptable materials. The list of acceptable materials must be the same as the materials recycled at the receiving material recovery facility or recycling processor.
- B. The collection containers for recyclable CDL waste must contain no more than 10% non-recyclable material, by volume.
- C. Provide containers for CDL waste that is disposed in a landfill clearly labeled as such.
- D. Use detailed material estimates to reduce risk of unplanned and potentially wasteful cuts.
- E. To the greatest extent possible, include in material purchasing agreements a waste reduction provision requesting that materials and equipment be delivered in packaging made of recyclable material, that they reduce the amount of packaging, that packaging be taken back for reuse or recycling, and to take back all unused product. Insure that subcontractors require the same provisions in their purchase agreements.

- F. Conduct regular visual inspections of dumpsters and recycling bins to remove contaminants.

3.2 SOURCE SEPARATION

- A. General: Contractor shall separate recyclable materials from CDL waste to the maximum extent possible.

Separate recyclable materials by type.

1. Provide containers, clearly labeled, by type of separated materials or provide other storage method for managing recyclable materials until they are removed from Project site.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water and to minimize pest attraction. Cover to prevent windblown dust.
3. Stockpile materials away from demolition area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from weather.

3.3 CO-MINGLED RECYCLING

- A. General: Do not put CDL waste that will be disposed in a landfill into a co-mingled CDL waste recycling container.

REMOVAL OF CONSTRUCTION WASTE MATERIALS

- A. Remove CDL waste materials from project site on a regular basis. Do not allow CDL waste to accumulate on-site.
- B. Transport CDL waste materials off Owner's property and legally dispose of them.
- C. Burning of CDL waste is not permitted.

END OF SECTION 017419

WASTE MANAGEMENT PROGRESS REPORT				
MATERIAL CATEGORY	DISPOSED IN MUNICIPAL SOLID WASTE LANDFILL	DIVERTED FROM LANDFILL BY RECYCLING, SALVAGE OR REUSE		
		Recycled	Salvaged	Reused
1. Acoustical Ceiling Tile				
2. Asphalt				
3. Asphalt Shingles				
4. Cardboard Packaging				
5. Carpet and Carpet Pad				
6. Concrete				
7. Drywall				
8. Fluorescent Lights and ballast				
9. Land Clearing Debris (vegetation, stumpage, dirt)				
10. Metals				
11. Paint (through hazardous waste outlets)				
12. Wood				
13. Plastic Film (sheeting, shrink wrap, packaging)				
14. Window Glass				
15. Field Office Waste (office paper, aluminum cans, glass, plastic, and coffee cardboard)				
16. Other (insert description)				
17. Other (insert description)				
Total (In Weight)		(TOTAL OF ALL ABOVE VALUES – IN WEIGHT)		
		Percentage of Waste Diverted	(TOTAL WASTE DIVIDED BY TOTAL DIVERTED)	

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Warranties.
 - 3. Final cleaning.
- B. See Division 01 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
- C. See Division 01 Section "Photographic Documentation" for submitting Final Completion construction photographs and negatives.
- D. See Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
- E. See Divisions 02 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.2 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, Final Completion construction photographs, 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. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 8. Complete final cleaning requirements, including touchup painting.

9. 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, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect 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 Architect, 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.

1.3 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 "Payment Procedures."
 2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. 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. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect 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. If more than one (1) reinspection is required all associated cost of that inspection including architect/engineering fees shall be the responsibility of the Contractor.

1.4 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 items applying to each major element, including categories.

1.5 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect 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.
- 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 or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average cleaning and maintenance program. 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 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 labels that are not permanent.
 - h. 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.
 - i. Remove excess mortar droppings, and other foreign substances.
 - j. 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.

END OF SECTION 017700

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings (As-built Drawings).
 - 2. Record Specifications (As- built Specifications).
 - 3. Record Product Data (As-built Product Data).
- B. See Divisions 02 through 33 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.2 SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set of marked-up Record Prints.
 - 2. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Initial Submittal: Submit one set of red marked as-built prints to the Architect. The Architect will approve via initials and date the prints and indicate whether general scope of changes, additional information recorded, and quality of mark-ups are acceptable as well as any other modifications are deemed necessary. If required by the Architect the Contractor shall, at no additional expense to the Owner or Architect, prepare a revised set of As-built Prints for submission and approval by the Architect. The Architect will return approved prints to the contractor to prepare additional required sets for final submittal.
 - b. Final Submittal: Submit one set of red marked As-built Prints to the Architect. As-built Prints must be identical to initial submission with required corrections.
- 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.

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. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 2. 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.
 3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each Record Drawing; include the designation "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. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - 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. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

2.3 COMPLETE PROJECT RECORD DOCUMENTS

- A. Preparation: Provide one complete set of Project Record Documents to the Owner.

2.4 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.

2.5 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 Architect's reference during normal working hours.

END OF SECTION 017839

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings & Piers.
 - 2. Slabs-on-grade.
- B. Related Sections:
 - 1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.
 - 2. Section 321313 "Concrete Paving" for concrete pavement and walks.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Construction and Control Joint Layout: Indicate proposed construction and control joints required to construct the structure.
 - 1. Location of joints is subject to approval of the Architect.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, manufacturer, and testing agency.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Curing compounds.
 - 4. Bonding agents.
 - 5. Vapor retarders.
 - 6. Joint-filler strips.
 - 7. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete,"
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- H. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - e. Special concrete finish subcontractor.
 - 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
1. Plywood, metal, or other approved panel materials.
 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch minimum.
- G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- H. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- I. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
 2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.

3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.
- D. Galvanized Reinforcing Bars: ASTM A 615, Grade 60 deformed bars, ASTM A 767/A 767M, Class I zinc coated after fabrication and bending.
- E. Epoxy-Coated Reinforcing Bars: ASTM A 615, Grade 60 deformed bars, ASTM A 775 or ASTM A 934, epoxy coated, with less than 2 percent damaged coating in each 12-inch (300-mm) bar length.
- F. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60 deformed bars, assembled with clips.
- G. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.
- H. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
 3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 1. Portland Cement: ASTM C 150, Type I or Type II. May be supplemented with the following:

- a. Fly Ash: ASTM C 618, Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source.
1. Maximum Coarse-Aggregate Size: 1-1/2 inches for foundations, 1 inch for walls and piers, and 3/4 inch for slabs.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94 and potable.

2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C 494, Type A.
 2. Retarding Admixture: ASTM C 494, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
 5. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

2.6 VAPOR RETARDERS

- A. See Section 071110: Under Vapor Retarder. Vapor retarders not in compliance with Specification 071110 will not be accepted.

2.7 LIQUID FLOOR TREATMENTS

- A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
1. Apply to all exposed concrete floors (reference architectural drawings).

2.8 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Solventborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A (non-yellowing).
 - 1. Products: Subject to compliance with requirements, acceptable manufacturers but are not limited to, the following]:
 - a. BASF Construction Chemicals.
 - b. Euclid Chemical Company (The).
 - c. L&M Construction Chemicals, Inc.
 - d. Meadows, W. R., Inc.
 - 2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.9 RELATED MATERIALS

- A. Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber for exterior locations and [ASTM D 1752, cork or self-expanding cork for interior locations.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types I and II, non-load bearing and Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than 0.022-inch thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.10 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.11 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 3000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.50
3. Slump Limit: 4 inches, plus or minus 1 inch .
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for exterior concrete.

B. Piers and Retaining Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch.

C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days. (4,500 psi for concrete subject to de-icing chemicals.)
2. Minimum Cementitious Materials Content: 470 lb/cu. yd. Maximum water-cementitious material ratio: 0.45 in non-air-entrained; 0.40 if air-entrained.
3. Slump Limit: 4 inches plus or minus 1 inch.
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.13 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.14 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 1. Class A, 1/8 inch for smooth-formed finished surfaces.
 2. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete and the concrete has achieved at least 75 percent of its 28 day design compressive strength.. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
 - 1. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
 - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643, manufacturer's written instructions and Specification Section 071110 under slab vapor retarder.

3.6 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.
- G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 3. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 4. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 5. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 6. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, and to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout

will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.
 - 1. Apply scratch finish to surfaces to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - 2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
 - 3. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch (3.2 mm).

- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- G. Slip-Resistive Finish: Before final floating, apply slip-resistive aluminum granule finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions.

3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (before and during finishing operations). Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after

loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
 - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 2. Application shall follow manufacturer's instructions.
 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.16 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Headed bolts and studs.
 4. Verification of use of required design mixture.
 5. Concrete placement, including conveying and depositing.
 6. Curing procedures and maintenance of curing temperature.
 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C 31.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

- E. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing.

3.17 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

CANNOT BE USED FOR BIDDING

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry joint reinforcement.
5. Ties and anchors.
6. Miscellaneous masonry accessories.

B. Related Sections:

1. Section 033000 "Cast-in-Place Concrete".
2. Section 051200 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural-steel frame.

1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
 2. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength.
 3. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
 4. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.
 5. Prism Test: For each type of construction required, according to ASTM C 1314.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.

1.7 INFORMATIONAL SUBMITTALS

- A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- B. Qualification Data: For testing agency.
- C. Material Certificates: For each type and size of the following:
1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 2. Cementitious materials. Include brand, type, and name of manufacturer.
 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 4. Grout mixes. Include description of type and proportions of ingredients.

5. Reinforcing bars.
 6. Joint reinforcement.
 7. Anchors, ties, and metal accessories.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
- F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

- D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.10 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide bullnose units for outside corners unless otherwise indicated.
- B. CMUs: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi Use higher strength masonry as required to meet minimum $f'm$ strength indicated.
 - 2. Density Classification: Normal weight unless otherwise indicated.
 - 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.

2.3 CONCRETE AND MASONRY LINTELS

- A. General: Provide one of the following as indicated on the drawings:
- B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.
- C. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Section 033000 "Cast-in-Place Concrete," and with reinforcing bars indicated.
- D. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Aggregate for Mortar: ASTM C 144.
 - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 - 2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
- E. Aggregate for Grout: ASTM C 404.
- F. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Euclid Chemical Company (The); Accelguard 80.
 - b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
 - c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.
- G. Water: Potable.

2.5 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).
- B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
 - 1. Interior Walls: Mill-galvanized, carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized, carbon steel.
 - 3. Wire Size for Side Rods: 0.187-inch (4.76-mm) diameter.
 - 4. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
 - 5. Wire Size for Veneer Ties: 0.187-inch (4.76-mm) diameter.
 - 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
 - 7. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.6 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
 2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.
 3. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
 4. Stainless-Steel Sheet: ASTM A 666, Type 304.
 5. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
 6. Stainless-Steel Bars: ASTM A 276 or ASTM A 666, Type 304.
- B. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall. Unless noted otherwise on the drawings, provide the following:
1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.35-mm-) diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.
 2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.25-inch- (6.35-mm-) diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls, unless otherwise indicated.
- C. Partition Top anchors: 0.105-inch- (2.66-mm-) thick metal plate with 3/8-inch- (9.5-mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel.
- D. Rigid Anchors: Fabricate from steel bars 1-1/2 inches (38 mm) wide by 1/4 inch (6.35 mm) thick bent to configuration indicated.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

2.7 MISCELLANEOUS ANCHORS

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.
- B. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.
- C. Postinstalled Anchors: Torque-controlled expansion anchors or chemical anchors as indicated on the drawing.
1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed

in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 unless otherwise indicated.
3. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.8 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
 - b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
 - c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
 - d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.9 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 1. Do not use calcium chloride in mortar or grout.
 2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
 3. For exterior masonry, use portland cement-lime or masonry cement mortar.
 4. For reinforced masonry, use portland cement-lime or masonry cement mortar.
 5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
 - 1. For masonry below grade or in contact with earth, use Type S.
 - 2. For reinforced masonry, use Type N.
 - 3. For mortar parge coats, use Type S or Type N.
 - 4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
 - 5. For interior non-load-bearing partitions, Type O may be used instead of Type N.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 - 2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
 - 3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Build chases and recesses to accommodate items specified in this and other Sections.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

- C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets.

Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches (100-mm). Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 - 1. Install compressible filler in joint between top of partition and underside of structure above.
 - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1200 mm) o.c. unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
 - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 - 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 - 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

- C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
 - 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
 - 2. Allow cleaned surfaces to dry before setting.
 - 3. Wet joint surfaces thoroughly before applying mortar.
- D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
 - 1. Space reinforcement not more than 16 inches (406 mm) o.c.
 - 2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
 - 1. Provide an open space not less than 1 inch (25 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 - 3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 24 inches o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.
 - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
 - 4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

3.9 LINTELS

- A. Provide concrete or masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.
- B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.10 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

3.11 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Inspections: Level 1 special inspections according to the "International Building Code."
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
- H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
- I. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

3.12 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

END OF SECTION 042200

CANNOT BE USED FOR BIDDING

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes structural steel and grout.

1.2 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.3 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents.
 - 1. Select and complete connections using schematic details indicated.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. W-Shapes: ASTM A 992
- C. Channels, Angles: ASTM A 36.
- D. Plate and Bar: ASTM A 36.

- E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- F. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
- G. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436 Type 1, hardened carbon-steel washers; all with plain finish.
- B. Unheaded Anchor Rods: [ASTM F 1554, Grade 36] [ASTM F 1554, Grade 55, weldable].
 - 1. Configuration: Hooked.
 - 2. Finish: Plain.
- C. Headed Anchor Rods: ASTM F 1554, Grade 36. straight.
 - 1. Finish: Plain.
- D. Threaded Rods: ASTM A 36.
 - 1. Finish: Plain.

2.3 PRIMER

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.4 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 - 2. Surfaces to be field welded.
 - 3. Surfaces to be high-strength bolted with slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
1. Liquid Penetrant Inspection: ASTM E 165.
 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 3. Ultrasonic Inspection: ASTM E 164.
 4. Radiographic Inspection: ASTM E 94.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate.
 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Snug tightened.

- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 051200

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Framing with engineered wood products.
3. Wood blocking, cants, and nailers.
4. Plywood backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Shear panels.
5. Power-driven fasteners.
6. Powder-actuated fasteners.
7. Expansion anchors.
8. Metal framing anchors.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Certified Wood: Materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
1. Dimension lumber framing.
 2. Laminated-veneer lumber.
 3. Parallel-strand lumber.
- B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
 3. Provide dressed lumber, S4S, unless otherwise indicated.
- C. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.
- D. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- E. Application: Treat items indicated on Drawings.

2.4 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.
 1. Application: Interior partitions not indicated as load-bearing.
 2. Species:
 - a. Mixed southern pine; SPIB.
 - b. Northern species; NLGA.
 - c. Eastern softwoods; NeLMA.

- d. Western woods; WCLIB or WWPA.
- B. Framing Other Than Non-Load-Bearing Interior Partitions: No. 2 grade.
1. Application: Framing other than interior partitions.
 2. Species:
 - a. Hem-fir (north); NLGA.
 - b. Southern pine; SPIB.
 - c. Douglas fir-larch; WCLIB or WWPA.
 - d. Mixed southern pine; SPIB.
 - e. Spruce-pine-fir; NLGA.
 - f. Douglas fir-south; WWPA.
 - g. Hem-fir; WCLIB or WWPA.
 - h. Douglas fir-larch (north); NLGA.
 - i. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
- C. Exposed Framing: Provide material hand-selected for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.
1. Application: Exposed interior framing indicated to receive a stained or natural finish.
 2. Species and Grade: As indicated above for load-bearing construction of same type.

2.5 ENGINEERED WOOD PRODUCTS

- A. Engineered Wood Products, General: Products shall contain no urea formaldehyde.] [comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.
1. Extreme Fiber Stress in Bending, Edgewise: 2900 psi (20.0 MPa).
 2. Modulus of Elasticity, Edgewise: 1,800,000 psi (12 400 MPa).

2.6 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
 2. Nailers.
 3. Rooftop equipment bases and support curbs.
 4. Cants.
 5. Furring.
 6. Grounds.

- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber of any species.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and [any of]the following species and grades:
 - 1. Mixed southern pine; No. 2 grade; SPIB.
 - 2. Eastern softwoods; No. 2 Common grade; NeLMA.
 - 3. Northern species; No. 2 Common grade; NLGA.
 - 4. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

2.7 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, Exterior, AC fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.
 - 1. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.8 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Power-Driven Fasteners: NES NER-272.
- C. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

2.9 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Cleveland Steel Specialty Co.
 - 2. KC Metals Products, Inc.
 - 3. Phoenix Metal Products, Inc.
 - 4. Simpson Strong-Tie Co., Inc.
 - 5. USP Structural Connectors.

- C. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- D. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- E. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.
 - 1. Use for wood-preserved-treated lumber and where indicated.

2.10 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch (25-mm) nominal thickness, compressible to 1/32 inch (0.8 mm); selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- C. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- D. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

- E. Shear Wall Panels: Install shear wall panels to comply with manufacturer's written instructions.
- F. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- G. Do not splice structural members between supports unless otherwise indicated.
- H. Comply with AWPAC M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- I. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- J. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 - 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

3.2 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Sheathing joint and penetration treatment.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For following products, from ICC-ES:

1. Preservative-treated plywood.
2. Fire-retardant-treated plywood.
3. Foam-plastic sheathing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

2.2 WOOD PANEL PRODUCTS

- A. Emissions: Products shall meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Certified Wood: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":
 - 1. Plywood.
 - 2. Oriented strand board.
 - 3. Particleboard underlayment.
 - 4. Hardboard underlayment.
- C. Plywood: Either DOC PS 1 or DOC PS 2 unless otherwise indicated.
- D. Oriented Strand Board: DOC PS 2.

2.3 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction, Use Category UC3b for exterior construction.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 - 2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F (76 deg C) shall be not less than span ratings specified.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat plywood indicated on Drawings.

2.5 WALL SHEATHING

- A. Plywood Wall Sheathing: Exposure 1, Structural I sheathing.
- B. Oriented-Strand-Board Wall Sheathing: Exposure 1, Structural I sheathing.
- C. Paper-Surfaced Gypsum Wall Sheathing: ASTM C 1396/C 1396M, gypsum sheathing; with water-resistant-treated core and with water-repellent paper bonded to core's face, back, and long edges.
 1. Type and Thickness: Regular, 1/2 inch (13 mm) or Type X, 5/8 inch (15.9 mm)] thick as indicated.
- D. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
 1. Type and Thickness: Regular, 1/2 inch (13 mm) or Type X, 5/8 inch (15.9 mm) thick as indicated.
- E. Cellulose Fiber-Reinforced Gypsum Sheathing: ASTM C 1278/C 1278M, gypsum sheathing.
 1. Type and Thickness: Regular, 1/2 inch (13 mm) or Type X, 5/8 inch (15.9 mm) thick as indicated.
- F. Cementitious Backer Units: ASTM C 1325, Type A.
 1. Thickness: As indicated.
- G. Extruded-Polystyrene-Foam Wall Sheathing: ASTM C 578, Type IV, with tongue-and-groove or shiplap long edges.
 1. Thickness: As indicated.
- H. Foil-Faced, Polyisocyanurate-Foam Wall Sheathing: ASTM C 1289, Type I or Type II, Class 2, rigid, cellular, polyisocyanurate thermal insulation. Foam-plastic core and facings shall have a flame-spread index of 25 or less when tested individually.
 1. Thickness: As indicated.

2.6 ROOF SHEATHING

- A. Plywood Roof Sheathing: Exposure 1, Structural I sheathing.
- B. Oriented-Strand-Board Roof Sheathing: Exposure 1, Structural I sheathing.

2.7 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

2.8 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 079200 "Joint Sealants."
- B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
 - 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.
- C. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

2.9 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
 - 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
 - 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
- D. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Wall and Roof Sheathing:
 - a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
 - b. Screw to cold-formed metal framing.
 - c. Space panels 1/8 inch (3 mm) apart at edges and ends.

3.3 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to wood framing with nails or screws.
 - 2. Fasten gypsum sheathing to cold-formed metal framing with screws.
 - 3. Install boards with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.

4. Install boards with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Seal sheathing joints according to sheathing manufacturer's written instructions.
1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
 2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

3.4 CEMENTITIOUS BACKER UNIT INSTALLATION

- A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 FOAM-PLASTIC SHEATHING INSTALLATION

- A. Comply with manufacturer's written instructions.
- B. Foam-Plastic Wall Sheathing: Install vapor-relief strips or equivalent for permitting escape of moisture vapor that otherwise would be trapped in stud cavity behind sheathing.
- C. Apply sheathing tape to joints between foam-plastic sheathing panels and at items penetrating sheathing. Apply at upstanding flashing to overlap both flashing and sheathing.

END OF SECTION 061600

SECTION 061753 - SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood roof trusses.
2. Wood girder trusses.
3. Wood truss bracing.
4. Metal truss accessories.

- B. Allowances: Provide wood truss bracing under the Metal-Plate-Connected Truss Bracing Allowance as specified in Section 012100 "Allowances."

1.2 ACTION SUBMITTALS

- A. Product Data: For metal-plate connectors, metal truss accessories, and fasteners.

- B. Shop Drawings: Show fabrication and installation details for trusses.

1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
2. Indicate sizes, stress grades, and species of lumber.
3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
6. Show splice details and bearing details.

- C. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.

- B. Evaluation Reports: For the following, from ICC-ES:

1. Metal-plate connectors.
2. Metal truss accessories.

1.4 QUALITY ASSURANCE

- A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
 - 1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
 - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that complies with quality-control procedures in TPI 1 and that involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction and is certified for chain of custody by an FSC-accredited certification body.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store trusses to comply with recommendations in TPI BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal-plate-connected wood trusses.
- B. Structural Performance: Provide metal-plate-connected wood trusses capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.

2.2 DIMENSION LUMBER

- A. Certified Wood: For metal-plate-connected wood trusses and permanent bracing, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Provide dry lumber with 19percent maximum moisture content at time of dressing.
- C. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 061000 "Rough Carpentry."

2.3 METAL CONNECTOR PLATES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Alpine Engineered Products, Inc.; an ITW company.
 2. Cherokee Metal Products, Inc.; Masengill Machinery Company.
 3. CompuTrus, Inc.
 4. Eagle Metal Products.
 5. Jager Building Systems, Inc.; a Tembec/SGF Rexfor company.
 6. MiTek Industries, Inc.; a subsidiary of Berkshire Hathaway Inc.
 7. Robbins Engineering, Inc.
 8. Truswal Systems Corporation; an ITW company.
- B. General: Fabricate connector plates to comply with TPI 1.
- C. Hot-Dip Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 (Z180) coating designation; and not less than 0.036 inch (0.9 mm) thick.

2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
 2. Where trusses are exposed to weather, in ground contact, made from pressure-preservative treated wood, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.

2.5 METAL FRAMING ANCHORS AND ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Cleveland Steel Specialty Co.
 2. KC Metals Products, Inc.
 3. Phoenix Metal Products, Inc.
 4. Simpson Strong-Tie Co., Inc.
 5. USP Structural Connectors.

- C. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those of basis-of-design products. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- D. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.

2.6 FABRICATION

- A. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
 - 1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- B. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wood trusses only after supporting construction is in place and is braced and secured.
- B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.
- C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- D. Install and brace trusses according to TPI recommendations and as indicated.
- E. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.
- F. Securely connect each truss ply required for forming built-up girder trusses.
- G. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
 - 1. Install bracing to comply with Section 061000 "Rough Carpentry."
 - 2. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.
- H. Install wood trusses within installation tolerances in TPI 1.
- I. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.

- J. Replace wood trusses that are damaged or do not meet requirements.

END OF SECTION 061753

CANNOT BE USED FOR BIDDING

SECTION 074600 - SIDING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes vinyl siding.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For vinyl siding, include VSI's official certification logo printed on product data.
- B. Samples: For siding including related accessories.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified vinyl siding Installer.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish full lengths of siding including related accessories, in a quantity equal to 2 percent of amount installed.

1.6 QUALITY ASSURANCE

- A. Vinyl Siding Installer Qualifications: A qualified installer who employs a VSI-Certified Installer on Project.

1.7 WARRANTY

- A. Special Warranty: Standard form in which manufacturer agrees to repair or replace siding that fail(s) in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 VINYL SIDING

- A. General: Integrally colored vinyl siding complying with ASTM D 3679.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:
 - a. Alcoa Home Exteriors, Inc.
 - b. CertainTeed Corp.
 - c. Owens Corning.
- B. Horizontal Pattern: 8-inch exposure in plain, double, 4-inch board style.
- C. Texture: Wood grain.
- D. Nominal Thickness: 0.044 inch.
- E. Nailing Hem: Double thickness.
1. Colors: As selected by Architect from manufacturer's full range of industry colors.

2.2 ACCESSORIES

- A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
1. Provide accessories matching color and texture of adjacent siding unless otherwise indicated.
- B. Aluminum Accessories: Where aluminum accessories are indicated, provide accessories complying with AAMA 1402.
1. Texture: Smooth.
 2. Nominal Thickness: 0.019 inch.
 3. Finish: Manufacturer's standard three-coat PVDF.
- C. Vinyl Accessories: Integrally colored vinyl accessories complying with ASTM D 3679 except for wind-load resistance.
1. Texture: Wood grain.
- D. Flashing: Provide stainless-steel flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.
- E. Fasteners:
1. For fastening to wood, use siding nails of sufficient length to penetrate a minimum of 1 inch into substrate.

2. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch, or three screw-threads, into substrate.
3. For fastening aluminum, use aluminum fasteners. Where fasteners will be exposed to view, use prefinished aluminum fasteners in color to match item being fastened.
4. For fastening vinyl, use aluminum fasteners. Where fasteners will be exposed to view, use prefinished aluminum fasteners in color to match item being fastened.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of siding and related accessories.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with siding manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
 1. Do not install damaged components.
 2. Center nails in elongated nailing slots without binding siding to allow for thermal movement.
- B. Install vinyl siding and related accessories according to ASTM D 4756.
 1. Install fasteners for horizontal vinyl siding no more than 16 inches o.c.
- C. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce weathertight installation.

3.3 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 074600

SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Adhered polyvinyl-chloride (PVC) roofing system.
2. Roof insulation.

- B. Section includes the installation of insulation strips in ribs of roof deck. Insulation strips are furnished under Section 053100 "Steel Decking."

C. Related Requirements:

1. Section 061000 " Misc.Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
2. Section 072100 "Thermal Insulation" for insulation beneath the roof deck.
3. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
4. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

- A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at the project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

B. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Roof plan showing orientation of steel roof deck and orientation of roofing, fastening spacings, and patterns for mechanically fastened roofing.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Samples for Verification: For the following products:

1. Sheet roofing, of color required.
2. Aggregate surfacing material in gradation and color required.
3. Walkway pads or rolls, of color required.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of compliance with performance requirements.
- C. Product Test Reports: For components of roofing system, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Research/Evaluation Reports: For components of roofing system, from ICC-ES.
- E. Field quality-control reports.
- F. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed and FM Global approved for roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
- B. Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, substrate board, roofing accessories, roof pavers, and other components of roofing system.
 - 2. Warranty Period: 20 years from date of Substantial Completion.
- C. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain components including roof insulation, fasteners, etc. for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.

1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
 2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
- B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Tested by a qualified testing agency to resist the following uplift pressures:
1. Corner Uplift Pressure: 90 lbf/sq. ft.
 2. Perimeter Uplift Pressure: 90 lbf/sq. ft.
 3. Field-of-Roof Uplift Pressure: 90 lbf/sq. ft.
- D. FM Global Listing: Roofing, base flashings, and component materials shall comply with requirements in FM Global 4450 or FM Global 4470 as part of a built-up roofing system, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
1. Fire/Windstorm Classification: Class 1A-90.
 2. Hail-Resistance Rating: MH.
- E. Solar Reflectance Index: Not less than **78** when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.
- F. Energy Star Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low slope roof products.
- G. Energy Performance: Roofing system shall have an initial solar reflectance index of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.
- H. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- I. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.3 PVC ROOFING

- A. PVC Sheet: ASTM D 4434/D 4434M, Type III, fabric reinforced and fabric backed.
1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - a. Carlisle SynTec Incorporated.
 - b. Cooley Engineered Membranes.

- c. Custom Seal Roofing.
 - d. Duro-Last Roofing, Inc.
 - e. Flex Membranes International.
 - f. GAF Materials Corporation.
 - g. GenFlex Roofing Systems.
 - h. Johns Manville.
 - i. Mule-Hide Products Co., Inc.
 - j. Sarnafil Inc.
 - k. Versico Incorporated.
2. Thickness: **60 mils** nominal.
 3. Exposed Face Color: White.

2.4 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.
 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content:
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Gypsum Board and Panel Adhesives: 50 g/L.
 - c. Multipurpose Construction Adhesives: 70 g/L.
 - d. Fiberglass Adhesives: 80 g/L.
 - e. Single-Ply Roof Membrane Adhesives: 250 g/L.
 - f. PVC Welding Compounds: 510 g/L.
 - g. Adhesive Primer for Plastic: 650 g/L.
 - h. Single-Ply Roof Membrane Sealants: 450 g/L.
 - i. Nonmembrane Roof Sealants: 300 g/L.
 - j. Sealant Primers for Nonporous Substrates: 250 g/L.
 - k. Sealant Primers for Porous Substrates: 775 g/L.
 - l. Other Adhesives and Sealants: 250 g/L.
 3. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.
- C. Bonding Adhesive: Manufacturer's standard.
- D. Slip Sheet: Manufacturer's standard, of thickness required for application.

- E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- F. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, prepunched.
- G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing to substrate, and acceptable to roofing system manufacturer.
- H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.5 SUBSTRATE BOARDS

- A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/4 inch thick.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corporation; GlasRoc Sheathing, GlasRoc Sheathing Type X.
 - b. Georgia-Pacific Corporation; Dens Deck, Dens Deck DuraGuard, Dens Deck Prime.
 - c. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.
 - d. Temple-Inland, Inc; GreenGlass Exterior Sheathing.
 - e. USG Corporation; Securock Glass Mat Roof Board.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate board to roof deck.

2.6 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by PVC roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Global-approved roof insulation.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Atlas Roofing Corporation.
 - b. Carlisle SynTec Incorporated.
 - c. Dyplast Products.
 - d. Firestone Building Products.
 - e. GAF Materials Corporation.

- f. Hunter Panels.
- g. Insulfoam LLC; a Carlisle company.
- h. Johns Manville.
- i. Rmax, Inc.

2.7 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
 - 1. Modified asphaltic, asbestos-free, cold-applied adhesive.
 - 2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
 - 3. Full-spread spray-applied, low-rise, two-component urethane adhesive.
- D. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

2.8 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch thick and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:
 - 1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
 - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 - 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
 - 4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.

5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
6. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Install insulation strips according to acoustical roof deck manufacturer's written instructions.

3.3 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- C. Install roofing and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

3.4 SUBSTRATE BOARD INSTALLATION

- A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
 1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Global's "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
 2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

3.5 VAPOR-RETARDER INSTALLATION

- A. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 inches and 6 inches, respectively. Seal laps by rolling.

- B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.6 INSULATION INSTALLATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
 - 1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
 - 1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
- G. Mechanically Fastened and Adhered Insulation: Install each layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 - 1. Fasten first layer of insulation according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
 - 2. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
 - 3. Set each subsequent layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.
 - 4. Set each subsequent layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
 - 5. Set each subsequent layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- H. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and fasten to roof deck.

1. Fasten cover boards according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
 2. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.
- I. Install slip sheet over insulation and immediately beneath roofing.

3.7 MECHANICALLY FASTENED ROOFING INSTALLATION

- A. Mechanically fasten roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.
1. Install sheet according to ASTM D 5082.
 2. For in-splice attachment, install roofing with long dimension perpendicular to steel roof deck flutes.
- B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- C. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Mechanically fasten or adhere roofing securely at terminations, penetrations, and perimeter of roofing.
- E. Apply roofing with side laps shingled with slope of roof deck where possible.
- F. In-Seam Attachment: Secure one edge of PVC sheet using fastening plates or metal battens centered within seam, and mechanically fasten PVC sheet to roof deck.
- G. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.
- H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

3.8 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.9 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.
- B. Roof-Paver Walkways: Install walkway roof pavers according to manufacturer's written instructions in locations indicated, to form walkways. Leave 3 inches of space between adjacent roof pavers.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.
 - 1. Electric Field Vector Mapping (EFVM): Testing agency shall survey entire roof area for potential leaks using electric field vector mapping (EFVM).
- B. Flood Testing: Flood test each roofing area for leaks, according to recommendations in ASTM D 5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
 - 1. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and not exceeding a depth of 4 inches. Maintain 2 inches of clearance from top of base flashing.
 - 2. Flood each area for 48 hours.
 - 3. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.
- C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.11 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.12 ROOFING INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

- 1. Owner: **Polytech Area School District**
- 2. Address: **PO Box 22
823 Walnut Shade Road
Woodside, DE 19980-0097**
- 3. Building Name/Type: **Polytech High School**
- 4. Address: **PO Box 22
823 Walnut Shade Road
Woodside, DE 19980-0097**
- 5. Area of Work: **Building Additions – See Drawings**
- 6. Acceptance Date: _____.
- 7. Warranty Period: **minimum 15 Years**
- 8. Expiration Date: _____.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

- 1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. lightning;
 - b. peak gust wind speed exceeding 90 mph ;
 - c. fire;

- d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
 - e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - f. vapor condensation on bottom of roofing; and
 - g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
 4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
 5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
 6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
 7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 075419

SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Roof-edge flashings.
 2. Roof-edge drainage systems.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each exposed product and for each color and texture specified.

1.3 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ROOF-EDGE FLASHINGS

- A. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet and a continuous formed- or extruded-aluminum anchor bar with integral drip-edge cleat to engage fascia cover. Provide matching corner units.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. [Hickman Company, W. P.](#)
 - b. [Johns Manville.](#)
 - c. [Metal-Era, Inc.](#)
 - d. [Metal-Fab Manufacturing, LLC.](#)

- e. [National Sheet Metal Systems, Inc.](#)
 - f. [Perimeter Systems; a division of Southern Aluminum Finishing Company, Inc.](#)
 - g.
2. Fascia Cover: Fabricated from the following exposed metal:
 - a. Formed Aluminum: Thickness as required to meet performance requirements.

2.2 ROOF-EDGE DRAINAGE SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. [Andreas Renner KG.](#)
 2. [Architectural Products Company.](#)
 3. [ATAS International, Inc.](#)
 4. [Berger Building Products, Inc.](#)
 5. [Castle Metal Products.](#)
 6. [Cheney Flashing Company.](#)
 7. [CopperCraft by FABRAL; a Euramax company.](#)
 8. [Hickman Company, W. P.](#)
 9. [Klauer Manufacturing Company.](#)
 10. [Merchant & Evans, Inc.](#)
 11. [Metal-Era, Inc.](#)
 12. [Metal-Fab Manufacturing, LLC.](#)
 13. [MM Systems Corporation.](#)
 14. [National Sheet Metal Systems, Inc.](#)
 15. [Perimeter Systems; a division of Southern Aluminum Finishing Company, Inc.](#)
- B. Gutters: Manufactured in uniform section lengths with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
 1. Fabricate from the following exposed metal:
 - a. Formed Aluminum: Match Existing.
 2. Gutter Profile: Match existing.
 3. Downspouts: Match existing.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use

fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
 2. Provide uniform, neat seams with minimum exposure of solder and sealant.
 3. Install roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
 4. Torch cutting of roof specialties is not permitted.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
- C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
1. Space movement joints at a maximum of 12 feet with no joints within of corners or intersections unless otherwise shown on Drawings.
 2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.
- D. Fastener Sizes: Use fasteners of sizes that will penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Seal joints with sealant as required by roofing-specialty manufacturer.
- F. Seal joints as required for watertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

3.2 ROOF-EDGE FLASHING INSTALLATION

- A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.3 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

- A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions.
- B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 30 inches apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.
 1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion joint caps.

- C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.

3.4 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as roof specialties are installed.

END OF SECTION 077100

CANNOT BE USED FOR BIDDING

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes joint sealants for the following applications:
 - 1. Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 2. Exterior joints in horizontal traffic surfaces.
 - 3. Interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 4. Interior joints in horizontal traffic surfaces.
- B. See Division 32 Section "Concrete Paving Joint Sealants" for sealing joints in pavements, walkways, and curbing.
- C. See Division 08 Section "Glazing" for glazing sealants.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Preconstruction field test reports.
- D. Compatibility and adhesion test reports.
- E. Product certificates.

1.4 QUALITY ASSURANCE

- A. Preconstruction Compatibility and Adhesion Testing: Submit samples of materials that will contact or affect joint sealants to joint-sealant manufacturers for testing according to ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

- B. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates according to the method in ASTM C 1193 that is appropriate for the types of Project joints.

1.5 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- D. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- E. Single-Component Mildew-Resistant Acid-Curing Silicone Sealant:
1. Products:
 - a. Pecora Corporation
 - b. Tremco; Dow Corning
 - c. Sonneborn
 2. Type and Grade: S (single component) and NS (nonsag).
 3. Class: 25.
 4. Use Related to Exposure: NT (nontraffic).
- F. Multicomponent Nonsag Urethane Sealant:
1. Products:
 - a. Pecora Corporation.
 - b. Tremco.
 - c. Polymeric Systems Inc
 - d. Sonneborn
 2. Type and Grade: M (multicomponent) and NS (nonsag).
 3. Class: 50.
 4. Uses Related to Exposure: NT (nontraffic) andT (traffic).

2.4 LATEX JOINT SEALANTS

- A. Latex Sealant: Comply with ASTM C 834, Type O P, Grade NF.
- B. Products:
1. Bostik Findley; Chem-Calk 600.
 2. Pecora Corporation; AC-20+.
 3. Schnee-Morehead, Inc.; SM 8200.
 4. Sonneborn, Division of ChemRex Inc.; Sonolac.
 5. Tremco; Tremflex 834.

2.5 PREFORMED JOINT SEALANTS

- A. Preformed Silicone-Sealant System: Manufacturer's standard system consisting of precured low-modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral-curing silicone sealant for bonding extrusions to substrates.

1. Products:

- a. Dow Corning Corporation; 123 Silicone Seal.
- b. GE Silicones; UltraSpan US1100.
- c. Pecora Corporation; Sil-Span.
- d. Tremco; Spectrem Ez Seal.

2.6 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

2.7 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.
1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.
 - a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.

2. Remove laitance and form-release agents from concrete.
 - a. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

- A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- B. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
- G. Installation of Preformed Silicone-Sealant System: Comply with manufacturer's written instructions.
- H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.
- I. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION 079200

SECTION 08 11 13 - STEEL DOORS AND FRAMES

1.1 GENERAL

1.01 Work Included

- A. The work under this section shall include the furnishing of all items shown on the drawings and as specified including, but not limited to, the following.
 - 1. Steel Doors
 - 2. Steel Door Frames
 - 3. Steel Sidelight, Borrowed lite & transom frames
 - 4. Louvers Installed in Steel Doors

1.02 Related Sections

- A. Section 04000: Masonry mortar
- B. Section 05500: Steel lintels
- C. Section 06200: Finish carpentry
- D. Section 08200: Wood Doors and Frames
- E. Section 08700: Finish Hardware
- F. Section 08800: Glass and Glazing
- G. Section 09900: Painting of steel doors and frames.

1.03 References

- A. Steel Doors and Frames in this section must meet all standards as established by the following listing.
 - 1. Door and Hardware Preparation ANSI 115.
 - 2. Life Safety Codes NFPA-101 (Latest edition).
 - 3. Fire Doors and Windows NFPA-80 (Latest edition).
 - 4. Steel Door Institute ANSI/SDI-100 (Latest edition)
 - 5. UL 10B Fire test of Door Assemblies and UL10C Standard for Positive Pressure Fire Tests of Door Assemblies
 - 6. Accessible and Usable Buildings and Facilities ICC/ANSI A117.1 (Latest edition)

1.04 Submittal

- A. Coordinate approved shop drawings with all other trades and manufacturers whose products are used in conjunction with the Steel Doors and Frames under section 08100.
- B. Finish hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.
- C. Each floor of the building is to be detailed separately.
- D. The steel door and frame supplier will furnish to the architect (4) complete copies of the proposed steel door and frames schedule and/or shop drawings. Using the same reference number for details and openings as those on the contract drawings. After receipt of the approved door schedule the steel door and frame supplier will make any corrections and submit to the architect (6) sets of corrected schedules.
- E. Upon request of the architect or for any substitution to this specification, (4) copies of the steel door & frame manufacturers catalog cut sheets are to be submitted to the architect before any material is placed on the job site.

1.05 Quality Assurance

- A. Provide Steel Doors and Frames complying with the Steel Door Institute recommended specifications for Standard Steel Doors and Frames ANSI/SDI 100 (Latest edition).
- B. Steel Doors and frames shall be manufactured to high quality standards in manufacturing facilities with annual certified conformance to ISO9001.

- 1.06 Delivery, Storage and Handling
- A. Doors and frames must be properly marked with door opening mark number to correspond with the schedule.
 - B. Deliver all steel doors with corrugated edge protection and palletized to provide protection during transit and job storage.
 - C. Inspect doors and frames upon delivery for damage. Minor damage is to be repaired, provided the repair is equal to new work and acceptable to the architect.
 - D. Store doors and frames at the job site under cover. Place units on wood sills on the floor in a manner that will prevent rust and damage. Avoid the use of non-vented plastic or canvas shelters, which could create a humidity chamber. If the wrapper on the door becomes wet, remove the carton immediately. Provide a ¼ inch space between stacked doors to promote air circulation.

Part 2 – Products

- 2.01 Acceptable Manufacturers - As long as they meet the following specifications:
- A. Ceco Door Products
 - B. Curries Company
 - C. Steelcraft
 - D. Other SDI or NAAMM members that conform to the specific requirements of this specification.
- 2.02 Hardware Locations and General Reinforcements
- A. Locate hardware on doors and frames in accordance with the manufacturer's standard location.
 - B. When steel frames are used with wood doors, the hardware preparation on the door is governed by the location on the frame. If the doors are factory mortised, the door supplier is responsible for coordinating hardware locations.
 - C. Hardware reinforcements are to be in accordance with the minimum standard gages as listed in SDI-100.
 - D. Doors shall be mortised, reinforced and function holes provided at the factory in accordance with the hardware schedule and templates provided by the hardware supplier. Through bolt holes, attachment holes, or drilling and tapping for surface hardware, shall be done by others in the field.
- 2.03 Steel Doors
- A. Material - Exterior and as indicated on the schedule
 - 1. Sheets are to be made of commercial quality 16 gage hot dipped zinc coated steel that complies with ASTM A924 A60.
 - 2. Vertical edges to have a hairline seam.
 - 3. Hinge reinforcement to be not less than 7 gage (3/16") plate 1-1/4" x 9".
 - 4. Reinforce tops and bottoms of all doors with a continuous steel channel not less than 16 gage, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel shall have a steel closure channel screwed or welded in place so the web of the channel is flush with the top of the face sheets of the door. Plastic fillers are NOT acceptable.
 - 5. Door Cores
Insulated doors are to be completely filled with a rigid polyurethane core chemically bonded to all interior surfaces with a minimum insulation value of R10.
 - 6. Acceptable Manufacturers:

- a. Ceco Door Products - Imperial
 - b. Curries Company - 707S x Urethane core
 - c. Steelcraft – L series x Polyurethane core
- B. Material - Interior and as indicated on the schedule
1. Sheets are to be made of commercial quality 18 gage cold rolled steel that complies to ASTM A366 or A620.
 2. Vertical edges to have a hairline seam.
 3. Hinge reinforcement to be not less than 7 gage (3/16") plate 1-1/4" x 9".
 4. Reinforce tops and bottoms of all doors with a continuous steel channel not less than 18 gage, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel shall have a steel closure channel screwed or welded in place so the web of the channel is flush with the top of the face sheets of the door. Plastic fillers are NOT acceptable.
 5. Door Cores
Doors are to be constructed of Kraft Honeycomb core with STC 32
 6. Acceptable Manufacturers:
 - a. Ceco Door Products - Regent
 - b. Curries Company - 707S x Honeycomb core
 - c. Steelcraft – L series x honeycomb core
- 2.04 Steel Frames
- A. Materials - Exterior Frames
1. To be 14 gage hot dipped zinc-coated steel that complies with ASTM designations A924 A60.
 2. All frames are to be assembled so that the face miter seam is "closed and tight". Weld the face seam of the frame corner or intersection. Grind and dress the weld area smooth. Apply a zinc rich primer over the grinding area, and finish with a matching prime paint.
 3. Acceptable Manufacturers:
 - a. Ceco Door Products – SU or SQ
 - b. Curries Company – M
 - c. Steelcraft - F
- B. Materials - Interior Frames.
1. To be 16 gage Cold rolled steel that complies to ASTM A366 or A620.
 2. All frames are to be assembled so that the face miter seam is "closed and tight". Weld the face seam of the frame corner or intersection. Grind and dress the weld area smooth. Apply a zinc rich primer over the grinding area, and finish with a matching prime paint.
 3. Acceptable Manufacturers:
 - a. Ceco Door Products – SU or SQ
 - b. Curries Company – M
 - c. Steelcraft - F
- C. Fabrication
1. Provide steel frames for doors, transoms, sidelights, borrowed lites, and other openings to the size and design as shown on the architectural drawings.
 2. All finished work shall be strong and rigid, neat in appearance, square, true and free of defects.
 3. Jamb depths, trim, profile and backbends to be as scheduled and shown on approved shop drawings.
 4. When shipping limitations so dictate, frames for large openings are to be fabricated in

sections for splicing or splining in the field by others.

5. Hardware reinforcements are to be in accordance with the minimum standard gages as listed in SDI-100.
 6. Frames shall be mortised, reinforced, drilled and tapped at the factory for template mortised hardware only, in accordance with approved hardware schedule and template provided by the hardware contractor .Where surface mounted hardware is to be applied, frames shall have reinforcing plates only; all drilling and tapping shall be done by others.
 7. Hinge reinforcements to be 7-gage steel.
- D. Anchors
1. Floor anchors to be provided at each jamb.
 2. Anchors for masonry walls to be of the wire type.
 3. Anchors for stud partitions to be steel of a suitable design, not less than 18-gage thickness,
 4. Dust boxes/mortar guards to be no less than 26 gage.
 5. All frames that are to be welded are to have a steel spreader temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not be used to size the frame opening.
 6. Loose glazing stops are to be of 16 gage galvanized steel, butted at corner joints and secured to the frame with countersunk cadmium or zinc-plated screws.
 7. Except on weather-stripped frames, punch the stop for 3 silencers on single door and 2 on double doorframes.
- 2.05 Labeled Doors and Frames
- A. Construct and install doors and frames to comply with current issue of National Fire Protection Association (NFPA) Standard Number 80, as herein specified.
 - B. Doors and/or frames for labeled openings shall bear either a stamped or applied label from Warnock Hersey or Underwriters Laboratory.
 - C. Provide 450 degree labels on stairways where required.
 - D. All doors and frames are to have been tested under UL10C and UBC 7 – 2 Positive Pressure fire testing.
- 2.06 Prime Finish:
- A. Doors and frames are to be cleaned, and chemically treated to insure maximum finish paint adhesion. All surfaces of the door and frame exposed to view shall receive a factory-applied coat of rust inhibiting primer. The finish to meet the requirements for acceptance stated in ANSI A250.10 "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces." The prime finish is not intended to be the final layer of protection from the elements. Field painting using a good grade of paint to be provided in accordance with the recommendations of the door and frame manufacturer. For specialty types of finished coatings, the paint supplier should also be consulted.

Part 3 – Execution

3.01 Inspection

- A. It is the responsibility of the installer to make sure that all dimensions for openings or existing frames (strike height, hinge spacing, hinge back set, etc.) given to the steel door and frame manufacturer are accurate.
- B. It is the responsibility of the installer to assure that scratches or disfigurements caused in shipping or handling are properly cleaned and touched up with a rust inhibitive primer.

3.02 Installation

- A. Frames
 1. Prior to installation, all frames must be checked for rack, twist and out of square

- conditions.
2. Place frames prior to enclosing walls and ceilings. Set frames accurately in position, plumbed and braced securely until permanent anchors are set. Remove shipping bar spreader and insert a wood spreader cut to the opening width, notched to clear the stops.
 3. Fill jambs in masonry walls with mortar, headers shall not be filled with mortar.
 4. When temperature conditions necessitate an additive to be used in the plaster or mortar to prevent freezing, the contractor installing the frames shall coat the inside of the frames, in the field, with a corrosion inhibiting bituminous material.
 5. SDI-105, "Recommended Erection Instructions for Steel Frames" and SDI-110 "Standard Steel Doors and Frames for Modular Masonry Construction" shall indicate the proper installation procedures.
- B. Doors
1. Install doors plumb and in true alignment in a prepared opening and fasten them to achieve the maximum operational effectiveness and appearance.
 2. Proper door clearance must be maintained in accordance with SDI - 110.
 3. Where necessary, only metal hinge shims are acceptable to maintain clearances.
 4. "Installation Guide for Doors and Hardware" published by DHI is recommended for further details.
- C. Hardware must be applied in accordance with hardware manufacturer's templates and instructions.
- 3.03 Adjust and clean
- A. Check and re-adjust operating finish hardware items in hollow metal work just prior to final inspection. Leave work in complete and proper condition.
 - B. Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply to touch-up or compatible air-drying primer.
- 3.04 Schedules
- A. After installation, copies of the door schedules are to be given to the owner when the building is accepted.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid core doors with wood veneer faces.
2. Field Finishing (see finishes specifications)
3. Factory fitting wood doors to frames and factory machining for hardware.
4. Louvers installed in flush wood doors.
5. Light frames and glazing installed in flush wood doors.

B. Related Sections:

1. Division 01 Section "Sustainable Design Requirements" for additional LEED documentation and requirements.
2. Division 08 Section "Hollow Metal Doors and Frames" for wood doors in steel frames.
3. Division 08 Section "Glazing" for glass view panels in wood doors.
4. Division 08 Section "Door Hardware" for door hardware for flush wood doors.
5. Division 09 Section "Finishes" for wood doors.

C. Standards and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A208.1 - Particleboard.
2. ASTM E90-90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
3. ASTM E 413 - Classification for Rating Sound Insulation.
4. Intertek Testing Service (ITS Warnock Hersey) - Certification Listings for Fire Doors.
5. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
6. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
7. UL 10C - Positive Pressure Fire Tests of Door Assemblies; UL 1784 - Standard for Air Leakage Tests of Door Assemblies.
8. United States Green Building Council (USGBC).
9. Window and Door Manufacturers Association - WDMA I.S.1-A Architectural Wood Flush Doors.

1.3 SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction, louvers, trim for openings, and WDMA I.S.1-A or AWS classifications.

- B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the wood door supplier in order to prepare the doors and frames to receive the finish hardware items.
- C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
 - 1. Indicate dimensions and locations of mortises and holes for hardware.
 - 2. Indicate dimensions and locations of cutouts.
 - 3. Indicate requirements for veneer matching.
 - 4. Indicate fire protection ratings for fire rated doors.
- D. Informational Submittals:
 - 1. LEED Documentation: Submit manufacturer's environmental documentation and applicable sustainability program credits that are available to contribute towards a LEED rated project certification.
- E. Warranty: Sample of special warranties.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, latest edition, "Industry Standard for Architectural Wood Flush Doors."
- C. Fire Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing at positive pressure according to NFPA 252 (neutral pressure at 40" above sill) or UL 10C (neutral pressure testing according to UL 10B where specified).
 - 1. Oversize Fire Rated Door Assemblies: For units exceeding sizes of tested assemblies provide manufacturer's construction label, indicating compliance to independent 3rd party certification agency's procedure, except for size.
 - 2. Temperature Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire test exposure.
 - 3. Smoke Control Door Assemblies: Comply with NFPA 105.
 - 1) Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
 - 4. Blocking: When through-bolts are not to be used, indicate size and location of blocking in 45, 60 and 90 minute mineral core doors
- D. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for receiving, handling, and installing flush wood doors.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - b. Telegraphing of core construction in wood face veneers exceeding 0.01 inch in a 3-inch span.
 - c. Telegraphing of core construction and delamination of face in decorative laminate-faced doors.
 - 2. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid Core Interior Doors: Life of installation according to manufacturer's written warranty.

PART 2 - PRODUCTS

2.1 DOOR CONSTRUCTION - GENERAL

- A. WDMA I.S.1-A Performance Grade: Heavy Duty; Aesthetic Grade: Custom.
- B. Particleboard Doors:
 - 1. Particleboard: Wood fiber based materials complying with ANSI A208.1 Particleboard standard. Grade LD-2.
 - 2. Adhesive: Fully bonded construction using Polyurethane (PUR) glue.
 - 3. Blocking: When through-bolted hardware is not used, provide wood blocking in particleboard core doors as follows:
 - a. 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.
 - b. 5-inch (125-mm) mid-rail blocking, in doors indicated to have exit devices.

- 1) Optional Cores for Blocking: Provide doors with structural-composite-lumber core instead of particleboard core for doors indicated to receive closers and exit devices.
- C. Mineral Core Doors:
1. Core: Non-combustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire protection rating indicated.
 2. Blocking: Provide composite blocking with improved screw holding capability approved for use in doors of fire protection ratings indicated as needed to eliminate through-bolting hardware.
 3. Edge Construction: At hinge stiles, provide laminated edge construction with improved screw holding capability and split resistance. Comply with specified requirements for exposed edges.
- D. Fire Rated Doors: Provide construction and core specified above as needed to provide fire ratings indicated.
1. Category A Edge Construction: Provide 45, 60 and 90 minute fire rated doors edge construction with intumescent seals concealed by outer stile (Category A). Comply with specified requirements for exposed edges.
 2. Pairs: Provide fire retardant stiles that are listed and labeled for applications indicated without formed steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
 - a. Where required or specified, provide formed steel edges and astragals with intumescent seals. Finish steel edges and astragals with baked enamel.
- E. Environmentally Responsible Doors: Provide where specified doors manufactured with the following environmentally responsible components:
1. Particleboard Core:
 - a. Low Emitting Materials: Interior wood flush doors must contain no added urea-formaldehyde resins.
- 2.2 VENEERED FACED DOORS FOR TRANSPARENT FINISH
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Interior Solid Core Doors:
1. Grade: Custom.
 2. Faces: "A" Grade faces. Face veneer minimum 1/50-inch (0.5mm) thickness at moisture content of 12% or less.
 3. Species: Natural Birch
 4. Cut: Rotary.
 5. Match between Veneer Leaves: Book match.
 6. Assembly of Veneer Leaves on Door Faces: Running match.
 7. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.

8. Vertical Edges: Matching same species as faces. Wood or composite material, one piece, laminated, or veneered. Minimum requirements per WDMA section P-1, Performance Standards for Architectural Wood Flush Doors.
9. Horizontal Edges: Solid wood or structural composite material meeting the minimum requirements per WDMA section P-1, Performance Standards for Architectural Wood Flush Doors
10. Construction: Five plies. Stiles and rails are bonded to core, then entire unit sanded before applying face veneers.

2.3 LOUVERS

- A. Wood Louvers: Door manufacturer's standard solid wood louvers unless otherwise indicated.
 1. Wood Species: Same species as door faces.
- B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less.
 1. Manufacturers: Subject to compliance with requirements, provide door manufacturers standard louver to meet rating indicated.
 2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish.

2.4 LIGHT OPENINGS AND GLAZING

- A. Wood Beads for Light Openings in Wood Doors up to and including 20-minute rating:
 1. Wood Species: Same species as door faces.
 2. Profile: Manufacturer's standard lipped profile. At wood core doors with 20-minute fire protection ratings, provide wood beads and metal glazing clips approved for such use
- B. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated.
- C. Glazing: Comply with requirements in Division 08 Section "Glazing" and with the flush wood door manufacturer's written instructions.
 1. Factory Glazing: Factory install glazing in doors as indicated. Doors with factory installed glass to include all of the required glazing material.

2.5 FABRICATION

- A. Factory fit doors to suit frame opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 1. Comply with requirements in NFPA 80 for fire rated doors.
- B. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

2. Metal Astragals: Factory machine astragals and formed steel edges for hardware for pairs of fire rated doors.
- C. Openings: Cut and trim openings through doors in factory.
 1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Field Glazing: Comply with applicable requirements in Division 08 Section "Glazing."
 3. Louvers: Factory install louvers in prepared openings.
- D. Electrical Raceways: Provide flush wood doors receiving electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through wire transfer hardware or wiring harness specified in hardware sets in Division 08 "Door Hardware". Wire nut connections are not acceptable.

2.6 FINISHING

- A. General: Comply with referenced quality standard for field finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Transparent Finish: Provide a clear protective coating over the wood veneer allowing the natural color and grain of the selected wood species to provide the appearance specified. Stain is applied to the wood surface underneath the transparent finish to add color and design flexibility.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Division 8 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
 1. Install fire rated doors in corresponding fire rated frames according to NFPA 80.
- C. Factory Fitted Doors: Align in frames for uniform clearance at each edge.

3.3 ADJUSTING

- A. Operation: Re-hang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

CANNOT BE USED FOR BIDDING

SECTION 081433- STILE AND RAIL WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior stile and rail wood doors.
2. Interior fire-rated stile and rail wood doors and wood frames.
3. Factory finishing stile and rail wood doors.
4. Factory fitting wood doors to frames and factory machining for hardware.
5. Louvers installed in stile and rail wood doors.
6. Light frames and glazing installed in stile and rail wood doors.

B. Related Sections:

1. Division 01 Section "Sustainable Design Requirements" for additional LEED documentation and requirements.
2. Division 06 Section "Interior Architectural Woodwork" for requirements for veneers from the same flitches for both architectural woodwork and stile and rail wood door panels.
3. Division 06 Section "Paneling" for requirements for veneers from the same flitches for both wood paneling and stile and rail wood door panels.
4. Division 08 Section "Hollow Metal Doors and Frames" for wood doors in steel frames.
5. Division 08 Section "Glazing" for glass view panels in stile and rail wood doors.
6. Division 08 Sections "Door Hardware" and "Access Control Hardware" for door hardware for stile and rail wood doors and wood frames.
7. Division 28 Section "Access Control" for access control devices installed at door openings and provided as part of a security access system.

C. Standards and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. Intertek Testing Service (ITS Warnock Hersey) - Certification Listings for Fire Doors.
2. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
3. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
4. Scientific Certification Systems (SCS) - Certified Products Standards.
5. UL 10C - Positive Pressure Fire Tests of Door Assemblies; UL 1784 - Standard for Air Leakage Tests of Door Assemblies.
6. United States Green Building Council (USGBC).
7. Window and Door Manufacturers Association - WDMA I.S.6-A Industry Standard for Architectural Stile and Rail Doors.

1.3 SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction, louvers, trim for openings, and WDMA I.S.6-A classifications. Include factory finishing specifications as applicable.
- B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the wood door supplier in order to prepare the doors and frames to receive the finish hardware items.
- C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
 - 1. Indicate dimensions and locations of mortises and holes for hardware.
 - 2. Indicate dimensions and locations of cutouts.
 - 3. Indicate requirements for veneer matching.
 - 4. Indicate doors to be factory finished and finish requirements.
 - 5. Indicate fire protection ratings for fire rated doors.
- D. Samples for Initial Selection: For each species and finish required.
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
 - 2. Corner sections of doors, 8 by 10 inches, with door faces and edges representing actual materials to be used.
 - a. Provide samples for each species of veneer and solid lumber required.
 - b. Finish veneer faced door samples with same materials proposed for factory finished doors.
 - 3. Frames for light openings, 6 inches long, for each material, type, and finish required.
- E. Warranty: Sample of special warranties.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Mark each door on top rail with opening number used on Shop Drawings.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 1. Temperature and Relative Humidity Requirements: Relative humidity to be 25 to 55 percent; temperature 60 to 80 degrees F (15.6 to 27.7 degrees C). Maintain required temperature and relative humidity in spaces where products will be installed for a

minimum of 24 hours before, during, and after installation as recommended by manufacturer.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form signed by manufacturer, installer, and contractor in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - 2. Warranty Period for Interior Stile and Rail Doors: One (1) year according to manufacturer's written warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 STILE AND RAIL DOOR CONSTRUCTION - GENERAL

- A. WDMA I.S.6-A Grade for Transparent Finish: Premium. Assemble doors, including components, with minimum WDMA Type II adhesives.
- B. WDMA I.S.6-A Grade for Opaque Finish: Custom. Assemble doors, including components, with minimum WDMA Type II adhesives.
- C. Fire Rated Doors: Provide construction and core specified above as needed to provide fire ratings indicated. Doors must be "true" stile and rail construction. "Simulated" or "sketch-faced" veneer faces are not acceptable.
 - 1. Interior Fire Rated Doors (20-Minute Rating): Fire rated doors with 1-3/4-inch (44-mm) thick stiles and rails complying with requirements indicated for interior doors.
 - 2. Interior Fire Rated Doors (45 and 60 Minute Ratings): Fire rated doors with 1-3/4-inch (44-mm) thick, edged and veneered non-combustible core stiles and rails complying with requirements indicated for interior doors.
 - 3. Interior Fire-Rated Doors (90 Minute Rating): Fire rated doors with 2-1/4-inch (57-mm) thick, edged and veneered non-combustible core stiles and rails complying with requirements indicated for interior doors.
 - 4. Pairs: Provide fire retardant stiles that are listed and labeled for applications indicated without formed steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
- D. Raised-Panel Thickness: Manufacturer's standard, but not less than 1-5/8 inches (41 mm) for 2-1/4 inch (57 mm) thick doors, 1-1/8 inches (29 mm) for 1-3/4 inch (44 mm) thick doors, and 3/4 inches (19 mm) for 1-3/8 inch (35 mm) thick doors.
- E. Flat-Panel Thickness: Manufacturer's standard, but not less than 1-1/8 inches (29 mm) for 2-1/4 inch (57 mm) thick doors, 5/8 inches (16 mm) for 1-3/4 inch (44 mm) thick doors, and 1/4 inch (6 mm) for 1-3/8 inch (35 mm) thick doors.

2.2 STILE AND RAIL DOORS FOR TRANSPARENT FINISH - INTERIOR

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. The Maiman Company.
 2. Substitutions: Requests for substitution and product approval in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.
- B. Interior Solid Core Doors:
1. Stile and Rail Construction: Veneered, minimum 1/16" before sanding; structural engineered core; edgebands same species as face veneer.
 2. Raised-Panel Construction:
 - a. Veneered, shaped, wood-based panel product with veneer conforming to raised-panel shape (3-ply veneer).
 - b. Veneered, wood-based panel product with mitered, raised rims made from matching clear lumber (rim-banded).
 3. Flat-Panel Construction: Veneered, wood-based panel product.
 4. Wood Species for Transparent Species: Red Oak.
 - a. Cut:
 - 1) Plain sawn.
 5. Size, Layout and Thickness: As indicated on Drawings.

2.3 FIRE RATED INTERIOR WOOD FRAMES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. The Maiman Company.
- B. Non-Rated and 20 Minute Fire Rated Wood Door Frames: Frames, complete with transom and sidelite frames, fabricated from veneered structural composite lumber for transparent finish or solid lumber close grained hardwood for opaque finish.
- C. Fire Rated (45, 60 and 90 Minute) Wood Door Frames: Frames, fabricated from veneered high density composite fire resistant board, with fire rating duration indicated.
- D. Wood Species for Transparent Finishes: Red Oak.
1. Cut:
 - a. Plain sliced (flat sliced).
- E. Frame Profiles: As indicated on Drawings.

2.4 FABRICATION

- A. Fabricate stile and rail wood doors in sizes indicated.

- B. Fit doors to suit frame opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 1. Comply with requirements in NFPA 80 for fire rated doors.
- C. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
 - 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 - 2. Metal Astragals: Factory machine astragals and formed steel edges for hardware for pairs of fire rated doors.
- D. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
- E. Openings: Trim openings indicated for glazing with solid wood moldings (non-rated and 20 minute fire-rated), with one side removable. For 45, 60, and 90-minute fire rated glazed openings, provide veneered metal for transparent finish doors (primed metal for opaque finish) for glazed openings
 - 1. Solid Wood Moldings: Trim openings with material and profile indicated.
 - 2. Field Glazing: Comply with applicable requirements in Division 08 Section "Glazing."
 - 3. Louvers: Factory install louvers in prepared openings.
- F. Electrical Raceways: Provide stile and rail wood doors receiving electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through wire transfer hardware or wiring harness specified in hardware sets in Division 08 "Door Hardware". Wire nut connections are not acceptable.

2.5 FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including machining for hardware that is not surface applied, before finishing.
- B. Door for Transparent Finish: Provide a clear protective coating over the wood veneer allowing the natural color and grain of the selected wood species to provide the appearance specified. Stain is applied to the wood surface underneath the transparent finish to add color and design flexibility.
 - 1. Grade: Premium.
 - 2. Finish: Meet or exceed WDMA TR6 Catalyzed Polyurethane finish performance requirements.
 - 3. Staining: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
 - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Division 8 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
 - 1. Install fire rated doors in corresponding fire rated frames according to NFPA 80.
- C. Factory Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated. Do not trim stiles and rails in excess of limits set by manufacturer or as permitted with fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.
 - 1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold. Bevel non-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
 - 2. Comply with NFPA 80 for fire rated doors.
- E. Factory Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Re-hang or replace doors that do not swing or operate freely.
- B. Replace doors that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081433

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Storefront framing for window walls.
2. Exterior and interior manual-swing entrance doors and door frame units.

1.2 PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferring to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Noise or vibration created by wind and by thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Failure of operating units.

B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Wind Loads: 100 mph.

D. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed $L/175$ of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to $3/4$ inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to $L/360$ of clear span or $1/8$ inch, whichever is smaller.

E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft..

- F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
- C. Samples: For each type of exposed finish required.
- D. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Product test reports.
- F. Field quality-control reports.
- G. Maintenance data.
- H. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
- E. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

- F. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.
- G. Preinstallation Conference: Conduct conference at Project site.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
 - 1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer Trifab VG 451 systems or a comparable product by one of the following:
 - 1. EFCO Corporation.
 - 2. EXTECH Exterior Technologies, Inc.
 - 3. Kawneer; an Alcoa Company.
 - 4. Thermal Windows, Inc.
 - 5. TRACO.
 - 6. Wausau Window and Wall Systems.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 - 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 - 4. Structural Profiles: ASTM B 308/B 308M.
 - 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and

pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 1. Construction: Nonthermal.
 2. Glazing System: Retained mechanically with gaskets on four sides.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
- E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials Dead-soft, 0.018-inch- thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer.
- F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Division 08 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

2.5 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.

1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 2. Door Design: Medium stile; 3-1/2-inch nominal width.
- B. Entrance Door Hardware: As specified in Division 08 Section "Door Hardware."
- C. Removable Mullions: BHMA A156.3, extruded aluminum.

2.6 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
 2. Accurately fitted joints with ends coped or mitered.
 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 4. Physical and thermal isolation of glazing from framing members.
 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 6. Provisions for field replacement of glazing. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing as specified in Division 08 Section "Glazing."

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.2 FIELD QUALITY CONTROL

A. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 084113

CANNOT BE USED FOR BIDDING

SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes fixed interior and exterior aluminum-framed windows.

1.2 PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of minimum test size required by AAMA/WDMA 101/I.S.2/NAFS.
- B. Structural Performance: Provide aluminum windows capable of withstanding the effects of the following loads, based on testing units representative of those indicated for Project that pass AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Structural Test:
 - 1. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at 33 feet above grade, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.
 - a. Basic Wind Speed: 120 mph.
 - 2. Deflection: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch, whichever is less, at design pressure based on testing performed according to AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Deflection Test or structural computations.
- C. Windborne-Debris Resistance: Where applicable by governing codes.
- D. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F material surfaces.

1.3 SUBMITTALS

- A. Product Data: For each type of aluminum window indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, and installation details

- C. Samples: For each exposed finish.
- D. Product Schedule: Use same designations indicated on Drawings.
- E. Field quality-control test reports.
- F. Product test reports.
- G. Maintenance data.

1.4 QUALITY ASSURANCE

- A. Installer: A qualified installer, approved by manufacturer to install manufacturer's products.
- B. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
- D. Preinstallation Conference: Conduct conference at Project site.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
 - c. Faulty operation of movable sash and hardware.
 - d. Deterioration of metals, other materials, and metal finishes beyond normal weathering.
 - e. Failure of insulating glass.
 - 2. Warranty Period:
 - a. Window: 5 years from date of Substantial Completion.
 - b. Glazing: 10 years from date of Substantial Completion.
 - c. Metal Finish: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer Trifab VG 451T fixed and Glassvent exterior window systems and Kawneer Trifab VG 450 fixed interior window systems or a comparable product by one of the following:
1. EFCO Corporation.
 2. EXTECH Exterior Technologies, Inc.
 3. Kawneer; an Alcoa Company.
 4. Thermal Windows, Inc.
 5. TRACO.
 6. Wausau Window and Wall Systems.

2.2 WINDOW

- A. Window Type: Screw spline 2"x4.5" center type frame systems as indicated on drawings and as indicated in the window schedule. Operable awning units are to be supplied as indicated.
- B. Comply with AAMA/WDMA 101/I.S.2/NAFS.
- C. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.
- D. Thermal Transmittance: Provide aluminum windows with a whole-window, U-factor maximum indicated at 15-mph exterior wind velocity and winter condition temperatures when tested according to ASTM E 1423.
1. U-Factor: 0.35 Btu/sq. ft. x h x deg F or less.
- E. Solar Heat-Gain Coefficient (SHGC): Provide aluminum windows with a whole-window SHGC maximum of 0.50, determined according to NFRC 200 procedures.

2.3 GLAZING

- A. Glass and Glazing Materials: Refer to Division 08 Section "Glazing" for glass units and glazing requirements applicable to glazed aluminum window units.

2.4 FABRICATION

- A. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.
- B. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator.
- C. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

- D. Provide water-shed members above side-hinged ventilators and similar lines of natural water penetration.
- E. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.
- F. Subframes: Provide subframes with anchors for window units as shown, of profile and dimensions indicated but not less than 0.062-inch- thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Finish to match window units. Provide subframes capable of withstanding design loads of window units.
- G. Glazing Stops: Provide snap-on glazing stops coordinated with Division 08 Section "Glazing" and glazing system indicated. Provide glazing stops to match sash and ventilator frames.

2.5 ALUMINUM FINISHES

- A. Aluminum Anodic Finish: Class I, clear anodic coating complying with AAMA 611.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.
- D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
- F. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- G. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
- H. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

3.2 FIELD QUALITY CONTROL

- A. Remove and replace noncomplying aluminum window as specified above.

END OF SECTION 085113

CANNOT BE USED FOR BIDDING

SECTION 087100 - DOOR HARDWARE

1.1 GENERAL:

- A. Submit final hardware schedule organized by "hardware sets," to indicate specifically the product to be furnished for each item required on each door.
 - 1. Furnish templates to each fabricator of doors and frames as required for hardware preparation.
- B. For fire-rated openings provide hardware tested and listed by UL or FM (NFPA Standard 80). On panic exit devices provide UL or FM label indicating "Fire Exit Hardware."

1.2 PRODUCTS:

- A. Manufacturers: Subject to compliance with requirements, provide products by manufacturers for various products listed below. An asterisk (*) following manufacturer's name designates manufacturer whose products are indicated in Hardware Schedule. Such products are listed in the schedule by specific reference to manufacturer's catalog numbers. Except as otherwise indicated, products of equivalent quality, design, and function by other listed manufacturers may be used, subject to approval of Architect.
 - 1. Butts and Hinges: Boston Hinge, Hager, McKinney*, PBB.
 - 2. Pivots: Rixson*.
 - 3. Locks and Latches: Corbin-Russwin, Sargent*, Yale.
 - 4. Cylinders: Corbin-Russwin Pyramid, Sargent Signature*, Yale KeyMark.
 - 5. Bolts: Glynn-Johnson, Hager, Ives, McKinney, Rockwood*, Trimco.
 - 6. Exit/Panic Devices: Corbin-Russwin, Sargent*, Yale.
 - 7. Push/Pull Units: Hager, McKinney, Rockwood*, Trimco.
 - 8. Overhead Closers: Corbin & Russwin, Norton*, Yale.
 - 9. Smoke-Activated Closers: Corbin-Russwin, Norton, Rixson, Yale.
 - 10. Floor Closers: Dor-O-Matic, Rixson.
 - 11. Door Control Devices: Hager, Ives, Trimco, Rockwood*.
 - 12. Door Trim Units: Hager, Ives, Trimco, Rockwood*.
 - 13. Kick, Mop, and Armor Plates: Trimco, Hager, Ives, Rockwood*.
 - 14. Sliding, Sliding Pocket, and Bifold Door Hardware: Henderson, L. E. Johnson.
 - 15. Door Stripping and Seals: DHSI*, Pemko*
 - 16. Thresholds: Hager, National Guard, Pemko*, Reese, Zero.
 - 17. Automatic Drop Seals and Astragals: Hager, National Guard, Pemko*, Reese, Zero.
 - 18. Sound Stripping: DHSI*, Pemko*.
 - 19. Electric Strikes: Folger-Adams, HES*, Locknetics.
 - 20. Door Position Switch: Locknetics, Securitron*, Sentrol.
- B. Finish and base material designations are indicated in accordance with ANSI BHMA A156.18 or the nearest traditional U.S. commercial finishes.

- C. Hinges and Pivots: Provide full-mortise butt, size, weight, and quantity in accordance with requirements established for door size, weight, and frequency of use.
1. Pins: Stainless steel, except steel pins with steel hinges; non-removable for exterior and public interior exposure; non-rising for non security exposure; flat button with matching plugs.
 2. Ball-Bearing: Swaged, inner leaf beveled, square corners.
 3. Plain-Bearing: Swaged, inner leaf beveled, square corners; except provide ball-bearing for doors equipped with closers.
- D. Locks, Latches, and Bolts:
1. Strikes: Wrought box strikes with extended lip for latch bolts, except open strike plates may be used in wood frames. Provide dust-proof strikes for foot bolts.
- E. Exit Devices: Equip exit devices with dogging devices where door has closer, except when door is fire-rated.
1. ANSI/BHMA A156.3 Grade 1 Heavy-duty exits with lever handles or pulls and UL listed and labeled for panic or fire rated.
 2. Exit devices and heavy duty trim shall carry 5 year limited warranty; electronic components shall carry 2 year limited warranty and utility trim carry 1 year warranty.
- F. Locks: Equip locks and cylinders with 6-pin removable core as listed in schedule with patented restricted keyway. New factory master key system.
1. Bored: ANSI A156.2 Series 4000 Grade 1 Heavy-duty locksets with latch bolt, lever handles and UL listed and labeled.
 2. Locksets & Latchsets shall carry 7 year warranty.
- G. Overhead Closers: Where parallel-arm closers are indicated, provide units one size larger than recommended for standard-arm units. Comply with ADA standards A117.1-2003.
1. Closer shall carry 10 limited year warranty for defects and life of building on the aluminum body.
- H. Combination Door Closers and Holders: Units designed to release and automatically close doors under fire conditions with integral electromagnetic holder mechanisms and UL listed fire detectors complying with UL 228.
- I. Holders, Stops, and Bumpers: Provide gray rubber exposed resilient parts.
1. Finish exposed metal to match hardware, except finish floor plates to match finish of thresholds.
 2. Size and mount units indicated or, if not indicated, to comply with manufacturer's recommendations for the exposure condition. Reinforce the substrate as recommended.

- J. Silencers: Provide silencers in metal door frames, unless not permitted for fire rating, or weather-stripping is provided; 3 per single-door frame, 2 per double-door frame.
- K. Miscellaneous Door Hardware: Provide plates, trim, letter box, viewers, knockers, bells, and similar units as indicated.
- L. Edge Trim: Fabricate units 1/16 inch to 1/2 inch smaller than actual door dimension. Install with self-tapping screws.
 - 1. Provide .050-inch-thick (16-gage) stainless steel with beveled edges and No. 4 polish for kick plates, armor plates, and edge protection stripping (regardless of finish or other hardware).
- M. Armor, Kick, and Mop Plates: Fabricate protection plates not more than 2 inches less than door width on stop side and not more than 1/2 inch less than door width on pull side, x the height indicated.
 - 1. Material: Stainless Steel, 0.050 inch (U.S. 16 gage).
- N. Weather-stripping: Provide type, size, and profile indicated, continuous at head and jamb edges of each exterior door opening. Provide non corrosive fasteners.
- O. Thresholds: Extruded aluminum of type, design, and profile indicated, complete with replaceable resilient vinyl wiper-type insert and non-corrosive fasteners.

1.3 EXECUTION:

- A. Hardware Mounting Locations: As recommended by the Door and Hardware Institute, unless indicated otherwise.
- B. Install each hardware item to comply with manufacturer's instructions and recommendations.
- C. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant. Remove excess sealant and clean adjacent surfaces.
- D. Hardware Adjustment: Installer to return to project six months after Owner's occupancy, and adjust hardware to proper operation and function. Instruct Owner's personnel in proper maintenance and adjustment.
- E. Hardware Schedule: Provide hardware for each door as in the following list of hardware sets:

Hardware Set # 1 (Doors: D01 – D02)
 Single Door, (Aluminum Storefront)

Each to have:

<u>Qty.</u>	<u>Type</u>	<u>Description</u>	<u>Finish</u>
1 ea.	Continuous Hinge	MCK-12HD x LAR x SER-12	628
1 ea.	Exit Device	55-56-64-8513 x ETL	630
1 ea.	Final Core	10-6300	626
1 ea.	Closer	CLP-7500-T x drop plate as req.	689
1 ea.	Power Supply	3550 x 738	
1 ea.	Switch, Door	Position, DPS-M-GR	Gray
1 ea.	eLynx Frame	Harness, QC-C1500P	
1 ea.	eLynx Door	Harness, QC-C*** (as required)	
1 ea.	Wiring Diagram	WITH POINT TO POINT	
1 ea.	Threshold	171A	AL
1 ea.	Sweep	Integral (by door Mfg.)	
1 ea.	Weather-strip	Integral (by door Mfg.)	

Notes: Above supplied by Finish Hardware supplier, Installation by Aluminum Door supplier, Access

Control Contractor and Electrical Contractor. Card Access by others. Valid card at reader (specified elsewhere) retracts the latch on the exit device allowing entry. Electric Latch Retraction can be dogged continuously to function in a push/pull manner. Devices contain request to exit switch which signal authorized egress to the access control system. Free egress at all times. Key override. Perimeter and meeting stile gasketing furnished by the door supplier.

Hardware Set # 2 (Doors: D03 – D04)
 Single Door, (Aluminum Storefront)

Each to have:

<u>Qty.</u>	<u>Type</u>	<u>Description</u>	<u>Finish</u>
1 sets	Pivot Set	147-3/4"	630
1 ea.	Intermediate Pivot	M19-3/4"	630
1 ea.	Dummy Bar	8893	630
1 ea.	Dummy Pull	862	630
1 ea.	Closer	CLP-7500-T x drop plate as req.	689
1 ea.	Threshold	171A	AL
1 ea.	Sweep	Integral (by door Mfg.)	
1 ea.	Weather-strip	Integral (by door Mfg.)	

Note: Above supplied by Finish Hardware supplier, Installation by Aluminum Door supplier.

Hardware Set # 3 (Door: D09)
Exterior Single Door

Each to have:

<u>Qty.</u>	<u>Type</u>	<u>Description</u>	<u>Finish</u>
2 ea.	Hinge	T4A3386 4-1/2" x 4-1/2" NRP	630
1 ea.	Hinge	T4A3386 4-1/2" x 4-1/2" x QC12	630
1 ea.	Elec. Strike	9600	630
1 ea.	ElectroLynx	Adapter, 2004M	
1 ea.	Exit Device	55-64-8813 x ETL	630
1 ea.	Final Core	10-6300	626
1 ea.	Closer	PR7500	689
1 ea.	Switch, Door	Position, DPS-M-GR	Gray
2 ea.	eLynx Frame	Harness, QC-C1500P	
1 ea.	Kick Plate	K1050, 8" X 2" LDW	630
1 ea.	Threshold	171A	AL
1 ea.	Sweep	315CN	AL
1 set	Weather-strip	CNS #105	
1 ea.	Overhead Drip	346C	AL

Notes: Above supplied by Finish Hardware supplier, Installation by Carpentry Contractor, Access Control Contractor and Electrical Contractor. Card Access by others. Valid card at reader (specified elsewhere) releases electric strike allowing entry. Key override.

Request to exit switch in rail signals authorized egress to the access control system. Free egress at all times.

Hardware Set # 4 (Doors: D05 – D07)
Single Door

Each to have:

<u>Qty.</u>	<u>Type</u>	<u>Description</u>	<u>Finish</u>
3 ea.	Hinge	T4A3786 4-1/2" x 4-1/2" NRP	630
1 ea.	Elec. Strike	1006 x J x 1006-105	630
1 ea.	ElectroLynx	Adapter, 2004M	
1 ea.	Lockset	28-64-10G04 LL (Storeroom)	626
1 ea.	Final Core	10-6300	626
1 ea.	Closer	7500	689
1 ea.	Switch, Door	Position, DPS-M-GR	Gray
1 ea.	eLynx Frame	Harness, QC-C1500P	
1 ea.	Kick Plate	K1050, 8" X 2" LDW	630
3 ea.	Silencer	608	Gray

Notes: Above supplied by Finish Hardware supplier, Installation by Carpentry Contractor, Access Control Contractor and Electrical Contractor. Card Access by others. Valid card at reader (specified elsewhere) releases electric strike allowing entry. Key override.

Request exit motion detector required (specified elsewhere) which signal authorized egress to the access control system. Free egress at all times.

Hardware Set # 5 (Door: D06)
Single Door

Each to have:

<u>Qty.</u>	<u>Type</u>	<u>Description</u>	<u>Finish</u>
3 ea.	Hinge	TA2714 4-1/2" x 4-1/2"	652
1 ea.	Lockset	28-64-10G37 LL (Classroom)	626
1 ea.	Final Core	10-6300	626
1 ea.	Closer	7500	689
1 ea.	Kick Plate	K1050, 8" X 2" LDW	630
1 ea.	Wall Stop	401	626
3 ea.	Silencer	608	Gray

Hardware Set # 6 (Door: D10)
Single Door

Each to have:

<u>Qty.</u>	<u>Type</u>	<u>Description</u>	<u>Finish</u>
2 ea.	Hinge, Spring	1502 4-1/2" x 4-1/2"	652
1 ea.	Latchset	28-10G15-3 LL (Exit latch)	626
1 ea.	Wall Stop	401	626
2 ea.	Silencer	608	Gray

Hardware Set # 7 (Door: D11)
Single Door

Each to have:

<u>Qty.</u>	<u>Type</u>	<u>Description</u>	<u>Finish</u>
3 ea.	Hinge	TA2714 4-1/2" x 4-1/2"	652
1 ea.	Lockset	28-64-10G04 LL (Storeroom)	626
1 ea.	Final Core	10-6300	626
1 ea.	Closer	7500	689
1 ea.	Kick Plate	K1050, 8" X 2" LDW	630
1 ea.	Wall Stop	401	626
3 ea.	Silencer	608	Gray

Hardware Set # 8 (Doors: D12 – D13)
Single Door

Each to have:

<u>Qty.</u>	<u>Type</u>	<u>Description</u>	<u>Finish</u>
3 ea.	Hinge	TA2714 4-1/2" x 4-1/2"	652
1 ea.	Latchset	28-10G37 LL (Passage)	626
1 ea.	Closer	7500	689
1 ea.	Kick Plate	K1050, 8" X 2" LDW	630
1 ea.	Wall Stop	401	626
3 ea.	Silencer	608	Gray

END OF SECTION 08710

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
1. Interior and exterior windows.
 2. Doors.
 3. Storefront framing.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 ICC's 2003 International Building Code by a qualified professional engineer, using the following design criteria:
1. Design Wind Pressures: 120 MPH
 2. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

1.3 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 QUALITY ASSURANCE

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. IGMMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

- B. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F, and the fire-resistance rating in minutes.
- D. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

1.5 WARRANTY

- A. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article.
- C. Windborne-Debris-Impact Resistance: As required by local applicable codes.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

A. Interior windows and doors: Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) 1/4" in thickness and tempered.

B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified and as below.

- | | |
|--|----------------------------|
| 1. Exterior Lite: | 1/4" Solarshield Grey. |
| 2. Airspace: | 1/2" |
| 3. Interior Lite: | 1/4" Clear Comfort Ti-AC#3 |
| 4. Visible Light Transmittance: | 30% |
| 5. Visible Light Reflectance Outdoors: | 9% |
| 6. Visible Light Reflectance Indoors: | 28% |
| 7. Solar Transmittance: | 17% |
| 8. Solar reflectance Outdoors: | 14% |
| 9. U.V. Light Transmittance: | 11% |
| 10. U.V. Damage Index - ISO: | 24% |
| 11. U-Value Winter -W/argon: | .024 |
| 12. U. Value Summer - W/argon | .022 |
| 13. Solar heat Gain Coefficient | .28 |
| 14. Shading Coefficient: | .32 |
| 15. Heat Gain - BTU/Hr/Sq. Ft. : | 69 |
| 16. Solar Heat Gain Ratio: | 1.07 |

2.3 GLAZING GASKETS

A. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.4 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- E. Provide spacers for glass lites where length plus width is larger than 50 inches.
- F. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- E. Install gaskets so they protrude past face of glazing stops.

3.3 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 088000

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Interior gypsum board.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.
2. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.

1.3 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for the following:

- a. Each level of gypsum board finish indicated for use in exposed locations.
- b. Each texture finish indicated.

2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.

3. Simulate finished lighting conditions for review of mockups.

4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Gypsum Co.
 - b. BPB America Inc.
 - c. G-P Gypsum.
 - d. Lafarge North America Inc.
 - e. National Gypsum Company.
 - f. PABCO Gypsum.
 - g. Temple.
 - h. USG Corporation.
- B. Regular Type:
1. Thickness: 5/8 & 1/2 inch.
 2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
- C. Type X:
1. Thickness: 5/8 inch.
 2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
- D. Special Type X: Having improved fire resistance over standard Type X, and complying with requirements of fire-resistance-rated assemblies indicated on Drawings.
1. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
 2. Long Edges: Tapered.
- E. Flexible Type: Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.
1. Thickness: 1/4 inch.
 2. Long Edges: Tapered.
- F. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.
1. Thickness: 1/2 inch.
 2. Long Edges: Tapered.
- G. Abuse-Resistant Type: Manufactured to produce greater resistance to surface indentation and through-penetration (impact resistance) than standard, regular-type and Type X gypsum board.
1. Core: Regular Type 5/8 inch, Type X.

2. Long Edges: Tapered.

H. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.

2.2 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.
 - g. Curved-Edge Cornerbead: With notched or flexible flanges.

2.3 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:

1. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
3. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."
- F. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."
- G. Vapor Retarder: As specified in Division 07 Section "Thermal Insulation."

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.

- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

3.2 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Regular Type: As indicated on Drawings.
 - 2. Type X: As indicated on Drawings.
 - 3. Ceiling Type: As indicated on Drawings.
 - 4. Foil-Backed Type: As indicated on Drawings.
 - 5. Moisture- and Mold-Resistant Type: As indicated on Drawings.

3.3 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

- A. Apply panels perpendicular to supports, with end joints staggered and located over supports.
 - 1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.
 - 2. Fasten with corrosion-resistant screws.

3.4 APPLYING TILE BACKING PANELS

- A. Water-Resistant Gypsum Backing Board: Install at showers, tubs, and where indicated. Install with 1/4-inch gap where panels abut other construction or penetrations.
- B. Glass-Mat, Water-Resistant Backing Panel: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.
- C. Cementitious Backer Units: ANSI A108.1, at locations indicated to receive tile.
- D. Areas Not Subject to Wetting: Install regular-type gypsum wallboard panels to produce a flat surface except at showers, tubs, and other locations indicated to receive water-resistant panels.
- E. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners, unless otherwise indicated.

3.6 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Level 5 for finish panels exposed to view.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 095123 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes acoustical tiles and suspension systems for ceilings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: Drawn to scale and coordinating acoustical tile ceiling installation with hanger attachment to building structure and ceiling mounted items. Show size and location of initial access modules.
- C. Samples: For each exposed finish.
- D. Product test reports.
- E. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory.
- B. Fire-Test-Response Characteristics:
 - 1. Fire-Resistance Characteristics: Where indicated, provide acoustical tile ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - a. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 2. Surface-Burning Characteristics: Acoustical tiles complying with ASTM E 1264 for Class A materials, when tested per ASTM E 84.
 - a. Smoke-Developed Index: 450 or less.

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size tiles equal to 2.0 percent of quantity installed.
2. Suspension System Components: Quantity of each concealed grid and exposed component equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL TILE CEILINGS, GENERAL

- A. Acoustical Tile Standard: Comply with ASTM E 1264.
- B. Metal Suspension System Standard: Comply with ASTM C 635.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- D. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 1. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- diameter wire.
- E. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

2.2 ACOUSTICAL TILES FOR ACOUSTICAL TILE CEILING

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
- B. Products: Indicated design is based on the following criteria as supplied by Armstrong World Industries or approved equal.
 1. Surface texture: Medium.
 2. Composition: Mineral fiber.
 3. Color: White
 4. Size: As indicated on drawings
 5. Product: "Fine Fissured"
- C. LR: Not less than .85.
- D. NRC: Not less than .55, Type E-400 mounting per ASTM E 795.
- E. CAC: Not less than 35.
- F. Edge/Joint Detail: tegular (excluding 2x4 lay in areas)

- G. Thickness: 5/8 inch.

2.3 METAL SUSPENSION SYSTEM FOR ACOUSTICAL TILE CEILING

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
- B. Products: Subject to compliance with requirements, provide one of the following:
 1. Armstrong World Industries, Inc.; Prelude XL 15/16" Exposed Tee.
 2. USG Interiors, Inc.; Approved equal.

2.4 ACOUSTICAL TILES FOR KITCHEN AND BAR AREAS

- A. A. Products: Indicated design is based on the following criteria as supplied by Armstrong World Industries or approved equal.
 1. 1. Surface texture: vinyl laminate
 2. 2. Composition: drywall
 3. 3. Color: White
 4. 4. Size: As indicated on drawings
 5. 5. Product: National Gypsum
- B. A. LR: Not less than .75
- C. B. NRC: Not less than NA
- D. C. CAC: Not less than NA
- E. D. Edge/Joint Detail: flat / lay in
- F. E. Thickness: 1/2"

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders.
- C. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices.

When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.

1. Do not support ceilings directly from permanent metal forms or floor deck; anchor into concrete slabs.
 2. Do not attach hangers to steel deck tabs or to steel roof deck.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical tile ceiling area and where necessary to conceal edges of acoustical tiles. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension system flanges into kerfed edges so tile-to-tile joints are closed by double lap of material.

END OF SECTION 095123

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient base.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

1.3 QUALITY ASSURANCE

1.4 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive resilient products.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

A. Resilient Base:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Johnsonite.
- b. Approved Equal

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Johnsonite Reveal
 2. Style: Straight (flat or toeless).
- C. Minimum Thickness: 1/4".
- D. Height: 4 inches.
- E. Lengths: Manufacturer standard 8' lengths.
- F. Outside Corners: Job mitered.
- G. Inside Corners: Job mitered.
- H. Finish: As selected by Architect from manufacturer's full range.
- I. Colors and Patterns: As indicated by manufacturer's designations.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are same temperature as the space where they are to be installed.
1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.2 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.

- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.

3.3 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vinyl composition floor tile.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
- C. Samples: Full-size units of each color and pattern of floor tile required.
- D. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.4 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive floor tile.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 VINYL COMPOSITION FLOOR TILE

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
1. AB ColorPlus, American Biltrite (Canada) Ltd.
 2. Armstrong World Industries, Inc.
 3. Congoleum Corporation;
 4. Mannington Mills, Inc.;
 5. Tarkett, Inc.;
 6. Vinylasa Tile, Distributed by American Tile Inc.
- B. Tile Standard: ASTM F 1066, Class 2, through-pattern tile.
- C. Wearing Surface: Embossed.
- D. Thickness: 0.125 inch
- E. Size: 12 by 12 inches
- F. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.
- C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by floor covering manufacturer. Proceed with installation only after substrates pass testing.
 - a. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until they are same temperature as space where they are to be installed.
 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.2 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 1. Lay tiles square with room axis.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 1. Lay tiles with grain running in one direction.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

- G. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.3 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.
- B. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.
 - 1. Apply two coat(s).
- C. Cover floor tile until Substantial Completion.

END OF SECTION 096519

CANNOT BE USED FOR BIDDING

SECTION 096813 – TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Modular Tufted Carpet Tile.
 - 2. Carpet installation.
- B. Related Sections include the following:
 - 1. Division 9 Section "Resilient Wall Base and Accessories" for resilient wall base and accessories installed with carpet.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate required.
- B. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
 - 2. Carpet type, color, and dye lot.
 - 3. Seam locations, types, and methods.
 - 4. Type of subfloor.
 - 5. Type of installation.
 - 6. Pattern type, repeat size, location, direction, and starting point.
 - 7. Pile direction.
 - 8. Type, color, and location of edge, transition, and other accessory strips.
 - 9. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet: 12-inch square Sample.
 - 2. Exposed Edge Stripping and Accessory: 12-inch long Samples.
 - 3. Carpet Seam: 18-inch Sample.

- D. Product Schedule: Use same room and product designations indicated on Drawings and in schedules.
- E. Maintenance Data: For carpet to include in maintenance manuals specified in Division 1. Include the following:
 - 1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
- B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Product Options: Products and manufacturers named in Part 2 establish requirements for product quality in terms of appearance, construction, and performance. Other manufacturers' products comparable in quality to named products and complying with requirements may be considered. Refer to Division 1 Section "Substitutions."
- D. Mockups: Before installing carpet, install mockups for each type of carpet installation required to demonstrate aesthetic effects and qualities of materials and execution. Install mockups to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Install mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect seven days in advance of dates and times when mockups will be installed.
 - 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 4. Obtain Architect's approval of mockups before starting work.
 - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 6. Approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with CRI 104, Section 5, "Storage and Handling."

1.6 PROJECT CONDITIONS

- A. General: Comply with CRI 104, Section 6.1, "Site Conditions; Temperature and Humidity."

- B. Environmental Limitations: Do not install carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.

1.7 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Carpet Warranty: Written warranty, signed by carpet manufacturer agreeing to replace carpet that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet: Full-width rolls equal to 7 percent of amount installed for each type indicated, but not less than 10 sq. yd.

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
- B. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Shaw Contract Flooring-
 - a. Pattern: 2square Tile (L7 Series)
 - b. Colors: 90585 Four Sided with Custom Accent Color
 - 2. Architect Approved Equal

- C. Fiber Content: 100% eco Q® solution
- D. Dye Method: 100% solution dyed
- D. Pile Characteristic: multi-level pattern loop
- E. Pile Thickness: .315
- F. Stitches: 12 per inch.
- G. Gauge: 1/12”
- H. Backing System: ecoworx
- I. Size: 24”x24”
- J. Applied Soil-Resistance Treatment: SSP®
- K. Antimicrobial Treatment: Manufacturer's standard material

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by the following:
 - 1. Carpet manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and that is recommended by the following:
 - 1. Carpet manufacturer.
- L. Seaming Cement: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.
- M. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Verify that substrates and conditions are satisfactory for carpet installation and comply with requirements specified.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by the following:
 - a. Carpet manufacturer.
 2. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving carpet.
 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPRATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and carpet manufacturer's written installation instructions for preparing substrates indicated to receive carpet installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by the following:
 1. Carpet manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Direct Glue Down Installation: Comply with CRI 104, Section 8 and 13, "Direct Glue-Down Installation."
- B. Provide Head Installer with a 24" x 24" sample of each product to be installed, one week prior to installation beginning. Supply architect with a copy of the transmittal of the sample delivery to head installer.
- C. Comply with carpet manufacturer's written recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
- D. Do not bridge building expansion joints with carpet.
- E. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.

- F. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
 - 2. Remove yarns that protrude from carpet surface.
 - 3. Vacuum carpet using commercial machine with face-beater element.
- B. Protect installed carpet to comply with CRI 104, Section 15, "Protection of Indoor Installations."
- C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer.

END OF SECTION 096813

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:
1. Hollow metal doors and frames
 2. Exposed mechanical piping and ductwork
 3. Unfinished materials as indicated on drawings
 4. Exposed unfinished electrical equipment

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each finish and for each color and texture required.

1.3 QUALITY ASSURANCE

- A. MPI Standards:
1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

- A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors: As selected by Architect from manufacturer's full range.

2.2 PRIMERS/SEALERS

A. Alkali-Resistant Primer: MPI #3.

1. VOC Content: E Range of E1 or greater type.

B. Bonding Primer (Water Based): MPI #17.

1. VOC Content: E Range of E1 or greater type.

C. Bonding Primer (Solvent Based): MPI #69.

1. VOC Content: E Range of E1 or greater type.

2.3 METAL PRIMERS

A. Alkyd Anticorrosive Metal Primer: MPI #79.

1. VOC Content: E Range of E1 or greater type.

B. Quick-Drying Alkyd Metal Primer: MPI #76.

1. VOC Content: E Range of E1 or greater type.

2.4 EXTERIOR ALKYD PAINTS

A. Exterior Alkyd Enamel (Flat): MPI #8 (Gloss Level 1).

1. VOC Content: E Range of E1.

B. Exterior Alkyd Enamel (Semigloss): MPI #94 (Gloss Level 5).

1. VOC Content: E Range of E1 or greater type.

C. Exterior Alkyd Enamel (Gloss): MPI #9 (Gloss Level 6).

1. VOC Content: E Range of E1 or greater type.

2.5 QUICK-DRYING ENAMELS

- A. Quick-Drying Enamel (Semigloss): MPI #81 (Gloss Level 5).
 - 1. VOC Content: E Range of E1 or greater type.
- B. Quick-Drying Enamel (High Gloss): MPI #96 (Gloss Level 7).
 - 1. VOC Content: E Range of E1 or greater type.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION AND APPLICATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.3 EXTERIOR PAINTING SCHEDULE

A. Steel Substrates:

1. Quick-Drying Enamel System: MPI EXT 5.1A.
 - a. Prime Coat: Quick-drying alkyd metal primer.
 - b. Intermediate Coat: Quick-drying enamel matching topcoat.
 - c. Topcoat: Quick-drying enamel (semigloss).
2. Alkyd System: MPI EXT 5.3B.
 - a. Prime Coat: Cementitious galvanized-metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel (semigloss).

END OF SECTION 099113

CANNOT BE USED FOR BIDDING

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
1. Gypsum board.
 2. Hollow metal doors and frames.
 3. Exposed ME&P items and equipment
 4. Exposed ductwork
 5. Inside of visible return air louvers
 6. Misc. steel fabrications indicated on drawings
 7. Concrete floor sealers and paint
 8. Misc. wood trim as indicated on the drawings
- B. Painting contractor shall be responsible for final touch up of all items determined by the Architect during final inspection.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each finish and for each color and texture required.
- C. Product List: Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.3 QUALITY ASSURANCE

- A. MPI Standards:
1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.
- B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft..

- b. Other Items: Architect will designate items or areas required.
2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
3. Final approval of color selections will be based on benchmark samples.
 - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

- A. Material Compatibility:
 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Chemical Components of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions; these requirements do not apply to primers or finishes that are applied in a fabrication or finishing shop:
 1. Flat Paints and Coatings: VOC content of not more than 50 g/L.
 2. Nonflat Paints and Coatings: VOC content of not more than 150 g/L.
 3. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 4. Restricted Components: Paints and coatings shall not contain any of the following:
 - a. Acrolein.
 - b. Acrylonitrile.
 - c. Antimony.
 - d. Benzene.
 - e. Butyl benzyl phthalate.

- f. Cadmium.
- g. Di (2-ethylhexyl) phthalate.
- h. Di-n-butyl phthalate.
- i. Di-n-octyl phthalate.
- j. 1,2-dichlorobenzene.
- k. Diethyl phthalate.
- l. Dimethyl phthalate.
- m. Ethylbenzene.
- n. Formaldehyde.
- o. Hexavalent chromium.
- p. Isophorone.
- q. Lead.
- r. Mercury.
- s. Methyl ethyl ketone.
- t. Methyl isobutyl ketone.
- u. Methylene chloride.
- v. Naphthalene.
- w. Toluene (methylbenzene).
- x. 1,1,1-trichloroethane.
- y. Vinyl chloride.

- C. Colors: As selected by Architect from manufacturer's full range.

2.2 BLOCK FILLERS

- A. Interior/Exterior Latex Block Filler: MPI #4.
 - 1. VOC Content: E Range of E2 or greater.

2.3 PRIMERS/SEALERS

- A. Interior Latex Primer/Sealer: MPI #50.
 - 1. VOC Content: E Range of E1 or greater.
- B. Interior Alkyd Primer/Sealer: MPI #45.
 - 1. VOC Content: E Range of E1 or greater.
- C. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

2.4 METAL PRIMERS

- A. Alkyd Anticorrosive Metal Primer: MPI #79.
 - 1. VOC Content: E Range of E1 or greater.

- B. Quick-Drying Alkyd Metal Primer: MPI #76.
 - 1. VOC Content: E Range of E1 or greater.
- C. Rust-Inhibitive Primer (Water Based): MPI #107.
 - 1. VOC Content: E Range of E1 or greater.
- D. Waterborne Galvanized-Metal Primer: MPI #134.
 - 1. VOC Content: E Range of E1 or greater.

2.5 WOOD PRIMERS

- A. Interior Latex-Based Wood Primer: MPI #39.
 - 1. VOC Content: E Range of E1 or greater.

2.6 LATEX PAINTS

- A. Interior Latex (Flat): MPI #53 (Gloss Level 1).
 - 1. VOC Content: E Range of E1 or greater.
- B. Interior Latex (Low Sheen): MPI #44 (Gloss Level 2).
 - 1. VOC Content: E Range of E1 or greater.
- C. Interior Latex (Eggshell): MPI #52 (Gloss Level 3).
 - 1. VOC Content: E Range of E1 or greater.
- D. Interior Latex (Satin): MPI #43 (Gloss Level 4).
 - 1. VOC Content: E Range of E1 or greater.
- E. Interior Latex (Semigloss): MPI #54 (Gloss Level 5).
 - 1. VOC Content: E Range of E1 or greater.
- F. Interior Latex (Gloss): MPI #114 (Gloss Level 6, except minimum gloss of 65 units at 60 deg).
 - 1. VOC Content: E Range of E1 or greater.
- G. Exterior Latex (Flat): MPI #10 (Gloss Level 1).
 - 1. VOC Content: E Range of E1 or greater.
- H. Exterior Latex (Semigloss): MPI #11 (Gloss Level 5).

1. VOC Content: E Range of E1 or greater.
- I. Exterior Latex (Gloss): MPI #119 (Gloss Level 6, except minimum gloss of 65 units at 60 deg).
 1. VOC Content: E Range of E1 or greater.
- 2.7 ALKYD PAINTS
- A. Interior Alkyd (Flat): MPI #49 (Gloss Level 1).
 1. VOC Content: E Range of E1 or greater.
 - B. Interior Alkyd (Eggshell): MPI #51 (Gloss Level 3).
 1. VOC Content: E Range of E1 or greater.
 - C. Interior Alkyd (Semigloss): MPI #47 (Gloss Level 5).
 1. VOC Content: E Range of E1 or greater.
 - D. Interior Alkyd (Gloss): MPI #48 (Gloss Level 6).
 1. VOC Content: E Range of E1 or greater.
- 2.8 QUICK-DRYING ENAMELS
- A. Quick-Drying Enamel (Semigloss): MPI #81 (Gloss Level 5).
 1. VOC Content: E Range of E1 or greater.
 - B. Quick-Drying Enamel (High Gloss): MPI #96 (Gloss Level 7).
 1. VOC Content: E Range of E1 or greater.
- 2.9 FLOOR COATINGS
- A. Interior/Exterior Clear Concrete Floor Sealer (Water Based): MPI #99.
 1. VOC Content: E Range of E1 or greater.
 - B. Interior/Exterior Clear Concrete Floor Sealer (Solvent Based): MPI #104.
 1. VOC Content: E Range of E1 or greater.
 - C. Interior/Exterior Latex Floor Paint (Low Gloss): MPI #60 (maximum Gloss Level 3).
 1. VOC Content: E Range of E2 or greater.
 2. Environmental Performance Rating: EPR 3.

- D. Exterior/Interior Alkyd Floor Enamel (Gloss): MPI #27 (Gloss Level 6).
 - 1. VOC Content: E Range of E1 or greater.
 - 2. Additives: Manufacturer's standard additive to increase skid resistance of painted surface.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry and CMU: 12 percent.
 - 3. Wood: 15 percent.
 - 4. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION AND APPLICATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
 - 1. Mechanical Work:

- a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
2. Electrical Work:
- a. Switchgear.
 - b. Panelboards.
 - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- E. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- F. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
- 3.3 INTERIOR PAINTING SCHEDULE
- A. Concrete Substrates, Traffic Surfaces:
1. Water-Based Clear Sealer System: MPI INT 3.2G.
 - a. First Coat: Interior/exterior clear concrete floor sealer (water based).
 - b. Topcoat: Interior/exterior clear concrete floor sealer (water based).
- B. CMU Substrates:
1. Latex System: MPI INT 4.2A.
 - a. Prime Coat: Interior/exterior latex block filler.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (eggshell).
- C. Steel Substrates:
1. Quick-Drying Enamel System: MPI INT 5.1A.
 - a. Prime Coat: Quick-drying alkyd metal primer.
 - b. Intermediate Coat: Quick-drying enamel matching topcoat.
 - c. Topcoat: Quick-drying enamel (semigloss).

- D. Galvanized-Metal Substrates:
1. Alkyd System: MPI INT 5.3C.
 - a. Prime Coat: Cementitious galvanized-metal primer.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior alkyd (eggshell).
- E. Dressed Lumber Substrates: Including architectural woodwork.
1. Latex System: MPI INT 6.3T.
 - a. Prime Coat: Interior latex-based wood primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (semigloss).
- F. Gypsum Board Substrates:
1. Latex System: MPI INT 9.2A.
 - a. Prime Coat: Interior latex primer/sealer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (flat) ceilings (eggshell) walls.

END OF SECTION 099123

SECTION 104413 - FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes fire protection cabinets for fire extinguishers.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- C. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 - 1. Sheet: ASTM B 209.
 - 2. Extruded Shapes: ASTM B 221.
- B. Transparent Acrylic Sheet: ASTM D 4801, Category A-1 (cell-cast sheet), 3 mm thick, with finish 1 (smooth or polished).

2.2 FIRE PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
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. Fire End & Croker Corporation.
 - b. J. L. Industries, Inc., a division of Activar Construction Products Group.
 - c. Kidde Residential and Commercial Division, Subsidiary of Kidde plc.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Aluminum.
- D. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
1. Rolled-Edge Trim: 2-1/2-inch.
- E. Cabinet Trim Material: Aluminum sheet Extruded-aluminum shapes.
- F. Door Material: Aluminum sheet Extruded-aluminum shapes.
- G. Door Style: Center glass panel with frame, frameless, with no exposed hinges.
- H. Door Glazing: Acrylic sheet.
1. Acrylic Sheet Color: Clear.
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- J. Accessories:
1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 2. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
 3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
- K. Finishes:
1. Manufacturer's standard baked-enamel paint for the following:

- a. Exterior of cabinet, door and trim, except for those surfaces indicated to receive another finish.
 - b. Interior of cabinet and door.
2. Aluminum: Baked enamel or powder coat.
 - a. Color: As indicated by manufacturer's designations.

2.3 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Miter and weld joints and grind smooth.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed and prepare recesses as required by type and size of cabinet and trim style.
- B. Install fire protection cabinets in locations and at mounting heights indicated, or if not indicated, at heights acceptable to authorities having jurisdiction.
- C. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
- D. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers mounted on walls or in cabinets as indicated on the drawings.
- B. SUBMITTALS
- C. Product Data: For each type of product indicated.
- D. Remaining paragraphs are defined in Division 01 Section "Submittal Procedures" as "Informational Submittals." Operation and maintenance data.
- E. Warranty: Sample of special warranty.

1.2 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
- C. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.3 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.
1. Basis-of-Design Product: Subject to compliance with requirements, provide or product by one of the following:
 - a. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International Ltd.
 - c. Badger Fire Protection; a Kidde company.
 - d. Buckeye Fire Equipment Company.
 - e. Fire End & Croker Corporation.
 - f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - g. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
 - h. Larsen's Manufacturing Company.
 - i. Moon-American.
 - j. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc.
 - k. Potter Roemer LLC.
 - l. Pyro-Chem; Tyco Safety Products.
 2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type: UL-rated 10 lb. nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

2.2 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

CANNOT BE USED FOR BIDDING

DIVISION 22 SECTION 22 05 00
COMMON WORK RESULTS FOR PLUMBING
TABLE OF CONTENTS

PART 1. GENERAL

- 1.1. SUMMARY
- 1.2. PERMITS AND FEES
- 1.3. EXAMINATION OF SITE
- 1.4. CONTRACTOR QUALIFICATION
- 1.5. MATERIALS AND EQUIPMENT
- 1.6. FIRE SAFE MATERIALS
- 1.7. REFERENCED STANDARDS, CODES AND SPECIFICATIONS
- 1.8. SHOP DRAWINGS
- 1.9. SUPERVISION AND COORDINATION
- 1.10. CUTTING AND PATCHING
- 1.11. CONNECTIONS AND ALTERATIONS TO EXISTING WORK
- 1.12. DEMOLITION
- 1.13. DEFINITIONS

PART 2. ELECTRICAL REQUIREMENTS – NOT USED

PART 3. EXECUTION

- 3.1. EQUIPMENT INSTALLATION - COMMON REQUIREMENTS
- 3.2. PROVISIONS FOR ACCESS
- 3.3. PAINTING AND FINISHES
- 3.4. CLEANING OF SYSTEMS
- 3.5. PROTECTION OF WORK
- 3.6. WALL AND FLOOR PENETRATIONS
- 3.7. WARRANTY
- 3.8. OUTAGES

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1. GENERAL

1.1. SUMMARY

- A. All work under Division 22 is subject to the Division 01, *General Requirements, the General Conditions and Supplementary Conditions*.
- B. Provide all labor, materials, equipment, and services necessary for and incidental to the complete installation and operation of all plumbing 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. Arrange piping, 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, 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 22 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.
- H. Remove and re-install existing plumbing fixtures as shown on the Contract Documents. Extend rough-in piping as required.

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.

1.4. CONTRACTOR QUALIFICATION

- A. Any Contractor or Subcontractor performing work under Division 22 shall be fully qualified and acceptable to the Architect 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. Existing items of equipment are being removed and reinstalled under this Division of these specifications. The Contractor shall be responsible for connecting all utilities as shown on the drawings, to equipment identified as existing.

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. ASPE - American Society of Plumbing Engineers
- C. ASTM - American Society for Testing and Materials
- D. IBC - International Building Code
- E. NSF - National Sanitation Foundation

1.8. SHOP DRAWINGS

- A. Contractor, additionally, shall submit for review any other shop drawings as required by the Architect. 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 Architect.

1.9. SUPERVISION AND COORDINATION

- A. Provide complete supervision, direction, scheduling, and coordination of all work under the Contract, including that of subcontractors.
- B. Coordinate all work under Division 22 with work under all other Divisions.
- C. 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.
- D. 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.

1.10. CUTTING AND PATCHING

- A. Accomplish all cutting and patching necessary for the installation of work under Division 22. 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.

1.11. CONNECTIONS AND ALTERATIONS TO EXISTING WORK

- A. Unless otherwise noted on the drawings, where existing plumbing work is removed all pipes, valves, 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 22 connects to existing equipment, piping, 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 22, or under other Divisions, requires relocation or reinstallation of existing equipment, piping, 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 indicated, 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.

1.12. DEMOLITION

- A. Unless otherwise noted all existing equipment, piping, etc., shall remain.
- B. Provide necessary piping, valves, traps, temporary feeds, etc., as required. Drain and refill piping systems as often as necessary to accommodate phasing and to minimize time lengths of outages.
- C. The Contractor shall be responsible for visiting the site and determining the existing conditions in which the work is to be performed.
- D. The location of all existing equipment, piping, etc., indicated is approximate only and shall be checked and verified. Install all new plumbing work to connect to or clear existing work as applicable.
- E. Maintain egress at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and the authorities having jurisdiction.
- F. At completion of project all temporary piping, valves, controls, etc., shall be removed in their entirety.
- G. 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.
- H. Before demolition begins, 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.
- I. The Owner shall have the first right of refusal for all plumbing fixtures, devices and equipment removed by the Contractor.
- J. 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.
- K. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation or re-installation.
- L. Terminate services and utilities in accordance with local laws, ordinances, rules and regulations.

1.13. 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. *Concealed* means hidden from sight in chases, formed spaces, shafts, hung ceilings, embedded in construction or attic .
- F. *Exposed* means not installed underground or *concealed* as defined above.
- G. *Invert Elevation* means the elevation of the inside bottom of pipe.
- 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. *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.
- J. *Building Line*: Exterior wall of building.

PART 2. ELECTRICAL REQUIREMENTS – NOT USED

PART 3. EXECUTION

3.1. EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment according to approved submittal data. Portions of the work are shown only in diagrammatic form. Refer conflicts to the Architect.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment giving right of way to piping installed at required slope.

3.2. PROVISIONS FOR ACCESS

- A. The contractor shall provide access panels and doors for all concealed equipment, valves, cleanouts, and other devices requiring maintenance, service, adjustment, or manual operation.

- B. Where access is by means of liftout ceiling tiles or panels, mark each ceiling grid using small color-coded and numbered tabs. Provide a chart or index for identification. Place markers within ceiling grid not on ceiling tiles.
- 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.

3.3. PAINTING AND FINISHES

- A. Clean surfaces prior to application of insulation, adhesives, coatings, paint, or other finishes.
- B. Protect all finishes and restore any finishes damaged as a result of work under Division 22 to their original condition.
- C. The preceding requirements apply to all work, whether exposed or concealed.
- D. Remove all construction marking and writing from exposed equipment, piping and building surfaces. Do not paint manufacturer's labels or tags.
- E. All exposed piping, equipment, etc. in finished spaces shall be painted. Colors shall be as selected by the Architect and conform to ANSI Standards.

3.4. 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. 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.
- C. Leave systems clean, and in complete running order.

3.5. 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 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.

3.6. WALL AND FLOOR PENETRATION

- A. Provide pipe escutcheons for sleeved pipes in finished areas.

3.7. WARRANTY

- A. Contractor's attention is directed to warranty obligations contained in the *General Conditions and Supplementary 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.

3.8. OUTAGES

- A. Provide a minimum of fourteen (14) 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 his 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: _____

DIVISION 23 SECTION 23 05 00
COMMON WORK RESULTS FOR HVAC
TABLE OF CONTENTS

PART 1. GENERAL

- 1.1. SUMMARY
- 1.2. PERMITS AND FEES
- 1.3. EXAMINATION OF SITE
- 1.4. CONTRACTOR QUALIFICATION
- 1.5. MATERIALS AND EQUIPMENT
- 1.6. FIRE SAFE MATERIALS
- 1.7. REFERENCED STANDARDS, CODES AND SPECIFICATIONS
- 1.8. SUBMITTALS, REVIEW AND ACCEPTANCE
- 1.9. SHOP DRAWINGS
- 1.10. SUPERVISION AND COORDINATION
- 1.11. CUTTING AND PATCHING
- 1.12. PENETRATION OF WATERPROOF CONSTRUCTION
- 1.13. CONCRETE AND MASONRY WORK
- 1.14. CONNECTIONS AND ALTERATIONS TO EXISTING WORK
- 1.15. DEMOLITION
- 1.16. VIBRATION ISOLATION
- 1.17. FASTENERS/CAPS
- 1.18. DEFINITIONS
- 1.19. MINIMUM EFFICIENCY REQUIREMENTS

PART 2. ELECTRICAL REQUIREMENTS

- 2.1. GENERAL MOTOR AND ELECTRICAL REQUIREMENTS
- 2.2. MOTORS AND CONTROLS
- 2.3. MOTOR INSTALLATION
- 2.4. WIRING DIAGRAMS

PART 3. EXECUTION

- 3.1. EQUIPMENT INSTALLATION - COMMON REQUIREMENTS
- 3.2. SUPPORTS, HANGERS AND FOUNDATIONS
- 3.3. PROVISIONS FOR ACCESS
- 3.4. PAINTING AND FINISHES
- 3.5. CLEANING OF SYSTEMS
- 3.6. COLOR SELECTION
- 3.7. PROTECTION OF WORK
- 3.8. OPERATION OF EQUIPMENT
- 3.9. IDENTIFICATION, FLOW DIAGRAMS, ELECTRICAL DIAGRAMS AND OPERATING INSTRUCTIONS
- 3.10. WALL AND FLOOR PENETRATIONS
- 3.11. RECORD DRAWINGS
- 3.12. WARRANTY
- 3.13. OPERATIONS AND MAINTENANCE MANUALS
- 3.14. INSTALLATION AND COORDINATION DRAWINGS
- 3.15. PIPING SYSTEMS TESTING
- 3.16. OUTAGES

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 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. 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. ACCA - Air Conditioning Contractors of America
- 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. ASTM - American Society for Testing and Materials
- I. IBC - International Building Code
- J. IEEE - Institute of Electrical and Electronics Engineers
- K. MSSP - Manufacturers Standards Society of the Valve and Fittings Industry
- L. NEC - National Electrical Code
- M. NEMA - National Electrical Manufacturers Association
- N. NSF - National Sanitation Foundation
- O. UL - Underwriters' Laboratories
- P. State of Delaware Fire Protection Regulations.
- Q. 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 Architect to be in best interest of Owner.
- B. After acceptance of Material and Equipment List, submit three (3) 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.

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

- Access Doors/Panels including layouts and locations
- Air Cooled Condensing Units and Heat Pumps
- Automatic Temperature Control Systems and Equipment
- Coordinated Drawings
- Exterior Piping Supports
- Fire Stopping - Methods and Materials
- Identification Systems
- Material and Equipment Lists

Operations and Maintenance Manuals
Pipe Materials Including Itemized Schedules
Preliminary Testing and Balancing Reports
Refnets
Split System Heat Pumps, Ductless
Test Certificates
Thermal Insulation Materials Include Table Summaries
Variable Refrigerant Volume Equipment
Vibration Isolation Materials
Weatherproof Assembly Components
Wiring Diagrams, Flow Diagrams and Operating Instructions

- E. Contractor, additionally, shall submit for review any other shop drawings as required by the Architect and/or 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 Architect.
- 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. Coordinate electrical work required under Division 23 with that under Division 26. Coordinate all work under Division 23 with work under all other Divisions.
- D. Supply services of an experienced (10 year minimum) and competent Project Manager to be in constant charge of work at site.
- E. 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.
- F. 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.

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 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.

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 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. 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.
- B. 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. 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 pipes in existing floors, walls, ceilings, etc., conflict with new work, remove abandoned pipes as necessary to accommodate new work.
- E. The location of all existing equipment, piping, ductwork, etc., indicated is approximate only and shall be checked and verified. Install all new mechanical/plumbing work to connect to or clear existing work as applicable.
- F. Maintain egress at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and the authorities having jurisdiction.
- G. Existing piping, equipment, ductwork, materials, etc., not required for re-use or re-installation in this project, shall be removed from the project site.
- H. 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.
- I. 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.
- J. Before demolition begins, 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.
- K. The Owner shall have the first right of refusal for all fixtures, devices and equipment removed by the Contractor.
- L. 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.
- M. 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.
- N. 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.
- O. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.
- P. Terminate services and utilities in accordance with local laws, ordinances, rules and regulations.

1.16. 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, *Vibration Control for HVAC, Plumbing and Fire Protection Equipment*.

1.17. FASTENERS/CAPS

- A. All fasteners located in public spaces including corridors, lobbies, toilet rooms, etc., shall be provided with tamper proof fasteners. Provide Pin Phillips hardware as manufactured by Challenge Industries or approved equal.
- B. For all exterior grade mounted equipment containing refrigerant install lockable caps on service valves to prevent tampering.

1.18. 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, embedded in construction or attic.
- 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, unexcavated spaces, crawl spaces, and tunnels.
- 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.

1.19. 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.

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 Electric Code. All wiring, conduit, etc., installed in ceiling plenums must be plenum rated per NFPA & BOCA.
- 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, 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 1.
- C. 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 WR^2 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.
- D. 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, unit heaters, humidifiers 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.
- E. Single phase motors, greater than 1/20 horsepower and less than 1/2 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.
- F. 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
1-1/2 HP	86.5 percent	85 percent
2HP	86.5 percent	85 percent
3HP	89.5 percent	86 percent
5HP	89.5 percent	87 percent
150 HP and above	96.0 percent	95 percent

- G. 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.
- H. 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.

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.

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.

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 Architect.
- 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.

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.

3.3. PROVISIONS FOR ACCESS

- A. Where access is by means of liftout ceiling tiles or panels, mark each ceiling grid using small color-coded and numbered tabs. Provide a chart or index for identification. Place markers within ceiling grid not on ceiling tiles.
- B. Submit shop drawings indicating the proposed location of all access panels/doors. Access doors in finished spaces shall be coordinated with air devices, and lighting 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.

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. Clean fans, enclosures, registers, grilles, and diffusers at completion of work.
- C. Install filters of equal efficiency to those specified in permanent air systems operated for temporary heating during construction. Replace with clean filters as specified prior to acceptance and after cleaning of system.
- D. 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.
- E. Leave systems clean, and in complete running order.

3.6. COLOR SELECTION

- A. Color of finishes shall be as selected by the Architect.
- 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, 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. IDENTIFICATIONS, FLOW DIAGRAMS, ELECTRICAL DIAGRAMS AND OPERATING INSTRUCTIONS

- A. 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).

- B. Provide three (3) 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.
- C. All lines 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, *HVAC Piping, Fittings, Valves*. 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.
- D. 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.
- E. Provide at least 8 hours of straight time instruction to the operating personnel. This instruction period shall consist of not less than one (1) 8 hour day. 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, *Instrumentation & Controls of HVAC & Plumbing Systems*.
- F. Contractor shall demonstrate Sequences of Operation of all equipment in presence of Owner's representative, Engineer, and ATC subcontractor.

3.10. WALL AND FLOOR PENETRATION

- A. All penetrations of partitions, ceilings, roofs 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, *Vibration Control for HVAC, Plumbing and Fire Protection 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, *Fire Protection, HVAC & Plumbing 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.

3.11. RECORD DRAWINGS

- A. Upon completion of the mechanical installations, the Contractor shall deliver to the Architect 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 Architect.

3.12. 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.

3.13. OPERATIONS AND MAINTENANCE MANUALS

- A. The Contractor shall have prepared three (3) copies of the Record and Information Booklet 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 – JP Court 3 & 17 Lobby – Renovations and Additions - 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 heat pumps.
 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. Copy of the approved balancing report.
 10. ATC systems including as-built ATC drawings of systems including internal of all panels.
 11. Access panel charts with index illustrating the location and purpose of access panels.
 12. Approved Electrical Certificates.
 13. Start-up reports for equipment.
- 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.

3.14. 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, 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.

3.15. 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
Coil Drain Piping	100 psi
Refrigerant Piping	400 psi with nitrogen

- B. 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*.
- C. Refrigerant piping shall be tested utilizing nitrogen per equipment manufacturer's requirements.

3.16. OUTAGES

- A. Provide a minimum of fourteen (14) 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 his 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: _____

DIVISION 23 SECTION 23 05 05
HVAC PIPING, FITTINGS AND VALVES
TABLE OF CONTENTS

PART 1. GENERAL

- 1.1. SUMMARY
- 1.2. SYSTEM DESCRIPTION CONDITIONS
- 1.3. QUALITY ASSURANCE
- 1.4. DELIVERY, STORAGE AND HANDLING

PART 2. PRODUCTS

- 2.1. PIPE MATERIALS
- 2.2. PIPE HANGERS
- 2.3. ESCUTCHEONS
- 2.4. SLEEVES

PART 3. EXECUTION

- 3.1. GENERAL PIPING INSTALLATION REQUIREMENTS
- 3.2. REFRIGERANT PIPING AND ACCESSORIES INSTALLATION REQUIREMENTS
- 3.3. HANGERS INSTALLATION REQUIREMENTS
- 3.4. PIPING IDENTIFICATION REQUIREMENTS
- 3.5. CLEANING PIPING AND EQUIPMENT

SECTION 230505 - 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, *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. Provide pipe hangers and supports in accordance with ASTM B31.9 and MSS SP69 unless indicated otherwise.

1.3. QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. 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 end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed systems.

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. Refrigeration Piping:

a). Tube Size $\frac{3}{4}$ -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 bronzed, AWS A5.8, BCUP silver/phosphorous/copper alloy with melting range 1190 to 1480 degrees F.

b). Soldered Joints: Solder joints using silver-lead solder, ASTM B 32, Grade 96 TS.

c). Brazed Joints: Braze joints using American Welding Society (AWS) classification BCuP-4 for brazing filler metal.

d). 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.

e). Diaphragm Packless Valves:

500-psig (3450-kPa) working pressure and 275 degrees Fahrenheit (135 degrees C) working temperature; globe design with straight-through or angle pattern; forged-brass or bronze body and bonnet, phosphor bronze and stainless-steel diaphragms, rising stem and handwheel, stainless-steel spring, nylon seat disc, and with solder-end connections.

f). Packed-Angle Valves: 500-psig (3450-kPa) working pressure and 275 degrees Fahrenheit (135 degrees C) working temperature; forged-brass or bronze body, forged-brass seal caps with copper gasket, back seating, rising stem and seat, molded stem packing, and with solder-end connections.

g). Service Valves: 500-psig (3450-kPa) pressure rating; forged-brass body with copper stubs, brass caps, removable valve core, integral ball check valve, and with solder-end connections.

2. Cooling Coil A/C Condensate Drain Piping:

a). Pipe & Fittings: All A/C condensate drain piping shall be constructed of Type L copper tubing, with sweat fittings made with 95-5 solder. Washout plugs (cleanouts) shall be strategically located to allow periodic flush out of

system. At a minimum, provide washout plugs at equipment connections and at direction changes of 90 degrees F or greater.

- B. Copper pipe shall be Revere, Anaconda or Chase with approved solder fittings.

2.2. PIPE HANGERS

- 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 3/4-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 - 1/2	6	8	3/8
2	8	8	3/8

- 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 1/2 to 1 1/2 inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring.
- D. Multiple or Trapeze hangers: Steel channels with welded spacers and hanger rods.
- E. Copper pipe support: Carbon steel ring, adjustable, copper plated.
- F. Hanger rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
- G. 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.

2.3. ESCUTCHEONS

- A. Provide stainless steel 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 stainless steel, and shall be set tight on the pipe and to the building surface. Plastic escutcheon plates will not be accepted.

2.4. SLEEVES

- A. Sleeves shall be provided around all pipes through walls, floors, ceilings, partitions, roof structure members 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 walls and floors shall be sealed with a waterproof caulking compound.
- C. Firestop at sleeves that penetrate smoke barriers smoke partitions and/or rated walls/floors.

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 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.
- B. 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.
- C. All valves, strainers, caps, and other fittings shall be readily accessible.
- D. Unions shall be installed 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.
- E. 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.
- F. Provide clearance for installation of insulation and access to valves and fittings.

- G. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

3.6. 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.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- M. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

- N. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- O. Identify refrigerant piping and valves.
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section, "Common Work Results for HVAC".
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section, "Common Work Results for HVAC".
- R. 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.
- S. 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).
- T. Furnish and install complete refrigerant piping systems between the indoor units and outdoor units. Support piping in accordance with Division 23 Section, *HVAC Piping, Fittings, Valves, Etc.* Piping shall be sized as recommended by unit manufacturer taking into account length of vertical and horizontal runs, and refrigerant type.
- U. Furnish and install all required piping accessories including, but not limited to, thermal expansion valves, Sporlan, or approved equal; Packless isolation valves at condenser and evaporator coil, Henry or approved equal, charging valve with chained seal cap, Henry or approved equal, sight glasses, Henry or approved equal; filter dryer with replaceable cartridge, sporland, or approved equal, liquid line solenoid valve 120V/1/60 Hz., Sporlan, or approved equal. Contractor shall provide traps and double suction risers if required by equipment manufacturer. Pitch piping for proper oil return. Submit shop drawings on all components, and piping arrangements.

- V. All accessories shall be ARI rated. Furnish required nitrogen and refrigerant to fully test and charge system. Flood piping system with nitrogen when brazing.
- W. Refrigerant piping shall be Type 1 hard temper (ACR) copper tubing with wrought copper colder fittings. Make joints with silver solder and non-corrosive flux.
- X. Refrigerant piping shall be cleaned, dehydrated and evacuated. Piping shall be evacuated and held to less than 2.5 mm Hg vacuum for a period of not less than 12 hours without appreciable pressure rise. Vacuum shall then be broken with refrigerant or dry nitrogen and re-evacuated to 2.5 mm Hg vacuum for an additional 12 hours. Piping test to be witnessed by Owner's representative and documented in writing. Submit results of tests to Architect/Engineer.
- Y. All refrigerant/suction lines sets shall be fully insulated. Exterior pipe insulation shall be fully jacketed as specified in Division 23 Section, *HVAC Insulation*.
- Z. Follow ASHRAE 15, latest edition procedures for charging and purging of systems and for disposal of refrigerant.
- AA. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.
- BB. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- CC. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- DD. Fully charge completed system with refrigerant after tested.
- EE. Install liquid indicators in liquid line leaving condenser, in liquid line, and on leaving side of liquid solenoid valves.
- FF. Install strainers immediately upstream from each automatic valve, including expansion valves, solenoid valves, hot-gas bypass valves, and compressor suction valves.
- GG. Install strainers in main liquid line where multiple expansion valves with integral strainers are used.
- HH. Install moisture-liquid indicators in liquid lines between filter-dryers and thermostatic expansion valves and in liquid line to receiver.
- II. Install flexible connectors at or near compressors where piping configuration does not absorb vibration.
- JJ. Test and inspect refrigerant piping according to ASME B31.5, Chapter VI.
1. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure.
 2. Test high- and low-pressure side piping of each system at not less than the lower of the design pressure or the setting of pressure relief device protecting high and low side of system.

- a). System shall maintain test pressure at the manifold gage throughout duration of test.
 - b). Test joints and fittings by brushing a small amount of soap and glycerin solution over joint.
 - c). Fill system with nitrogen to raise a test pressure of 150 psig (1035 kPa) or higher as required by authorities having jurisdiction.
 - d). Remake leaking joints using new materials, and retest until satisfactory results are achieved.
- KK. Adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.
- LL. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
1. Open shutoff valves in condenser water circuit.
 2. Check compressor oil level above center of sight glass.
 3. Open compressor suction and discharge valves.
 4. Open refrigerant valves, except bypass valves that are used for other purposes.
- MM. Before installing copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene.
- NN. Replace core of filter-dryer after system has been adjusted and design flow rates and pressures are established.
- OO. Charge system using the following procedures:
1. Install core in filter-dryer after leak test but before evacuation.
 2. Evacuate entire refrigerant system with a vacuum pump to a vacuum of 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
 4. Charge system with a new filter-dryer core in charging line. Provide full-operating charge.

3.7. HANGERS 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 structural engineer's recommendations.
- J. Refer to structural documents for appropriate connection/attachment materials to building.

3.8. PIPING IDENTIFICATION INSTALLATION

- 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
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3.9. CLEANING PIPING AND EQUIPMENT

- A. All condensate piping system shall be flushed clean with fresh water.

END OF SECTION

CANNOT BE USED FOR BIDDING

DIVISION 23 SECTION 23 05 48
VIBRATION CONTROLS FOR HVAC, PLUMBING AND FIRE PROTECTION EQUIPMENT

TABLE OF CONTENTS

PART 1 GENERAL

- 1.1 GENERAL
- 1.2 SUMMARY
- 1.3 SUBMITTALS

PART 2 PRODUCTS

- 2.1 MANUFACTURER
- 2.2 CORROSION PROTECTION FOR STEEL PARTS
- 2.3 NEOPRENE
- 2.4 RUBBER MOUNTS

PART 3 EXECUTION

- 3.1 GENERAL PROVISIONS
- 3.2 ISOLATION FOR SPECIFIC EQUIPMENT
- 3.3 MANUFACTURER'S FIELD SERVICES

CANNOT BE USED FOR BIDDING

SECTION 23 05 48 - VIBRATION CONTROLS FOR HVAC, PLUMBING AND FIRE PROTECTION 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, *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, 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.

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.

2.1 NEOPRENE

- A. Grade durometer 40, 50 OR 60 AND OIL RESISTANT.

2.2 RUBBER MOUNTS

- A. Molded rubber designed for 0.6 inches (13 mm) deflection with threaded insert.

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. 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.
- C. 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.
- D. 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.
- E. 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.
- F. 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 360° without touching any object.

- G. 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.
- H. Install in accordance with manufacturer's instructions.
- I. Install isolation for motor driven equipment.
- J. Install spring hangers without binding.
- K. Connect wiring to isolated equipment with flexible hanging loop.

3.2 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. Ductless Units: Indoor ductless units shall be supported with rubber grommet type suspension isolators. Outdoor ductless units shall be supported on ribbed neoprene pads resting on concrete pad.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Inspect isolated equipment after installation and submit report. Include static deflections.

END OF SECTION

DIVISION 23 SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC AND PLUMBING
TABLE OF CONTENTS

PART 1. GENERAL

- 1.1. GENERAL
- 1.2. EXAMINATION
- 1.3. QUALIFICATIONS OF THE BALANCE AGENCY
- 1.4. STANDARDS
- 1.5. COORDINATION
- 1.6. RESPONSIBILITIES OF THE MECHANICAL CONTRACTOR
- 1.7. RESPONSIBILITIES OF THE CONTRACTOR
- 1.8. NOTIFICATION FOR TESTING AND BALANCING WORK TO BEGIN
- 1.9. DEFICIENCIES
- 1.10. ADJUSTING

PART 2. PRODUCTS (NOT APPLICABLE)

PART 3. EXECUTION

- 3.1. GENERAL
- 3.2. EXAMINATION
- 3.3. AIR SYSTEM PROCEDURES
- 3.4. VERIFICATION OF TEMPERATURE CONTROL
- 3.5. TEST AND BALANCE REPORTS
- 3.6. TEST REPORT FORMS

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC AND PLUMBING

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, *Heating, Ventilating, and Air Conditioning Equipment* and in Division 22 Section, *Plumbing Fixtures and Plumbing Equipment*.
- B. For *Common Work Results of HVAC*, See Division 23. 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:

Air Systems:

Coils (Air Temperatures & Static Pressure Drops)
Ductless Split System Units (Indoors and Outdoor)
Variable Refrigerant Volume Systems

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. Air coil fins are cleaned and combed.
- B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.

- C. Beginning of work means acceptance of existing conditions.

1.3. QUALIFICATIONS OF THE BALANCE AGENCY

- A. The balancing agency shall be a member of the Associated Air Balance Council (AABC) and have an engineer certified by the National Examining Board.
- 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 and officially stamped by the certified test and balance engineer.

1.4. 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. ADC: Test Code for grills, registers, and diffusers.
- D. ASHRAE III: Practice for measurement, testing, adjusting and balancing of building heating, ventilation, air conditioning, and refrigeration systems.
- E. NEBB: Procedure standards for testing, adjusting, and balancing of environmental systems.
- F. SMACNA: HVAC systems testing, adjusting, and balancing.
- G. AABC: Associated Air Balance Council

1.5. COORDINATION

- A. It will be necessary for the balancing agency to perform its services in close coordination with the mechanical contractor.
- B. 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.

1.6. 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. Install clean filters.

1.7. RESPONSIBILITIES OF THE 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.
 - 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.

1.8. 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. Equipment properly started by qualified personnel or start-up technicians.

2. Ceiling tiles installed.
3. Automation system (temperature controls) installed and completed.
4. All equipment controlled in automatic (“Auto”) mode.
5. Access granted to the balancing contractor to the automation/controls system provided.

1.9. 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.

1.10. ADJUSTING

- A. Ensure recorded data represents actual measured observed conditions.
- B. Leave systems in proper working order, closing access doors, closing doors to electrical switch boxes, and restoring all sensors to specified settings.
- C. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- D. Check and adjust systems approximately six months after final acceptance and submit report.

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 six (6) months prior to use and shall be checked for accuracy prior to and during the work.
- 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.

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 the approved submittals for HVAC systems and equipment.
- C. 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.
- D. Examine system and equipment installations and verify that field quality-control testing, cleaning and adjusting specified in individual Sections have been performed.
- E. Examine test reports specified in individual system and equipment Sections.
- F. Examine terminal units, and verify that they are accessible and their controls are connected and functioning.
- G. Examine operating safety interlocks and controls on HVAC equipment.
- H. 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. Air Temperature - Take wet-bulb and dry-bulb air temperatures on the entering and leaving side of each cooling coil. Dry-bulb temperature shall be taken on the entering and leaving side of each heating coil.
4. For all equipment specified with condensate overflow safety switches/floats test operation of such device and record results. Verify interlock with ATC system.

3.4. 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.

3.5. 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. Three (3) 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 Architect
 6. Project Mechanical Engineer

7. Test & Balance Agency
 8. Test & Balance Engineer
 9. General Contractor/Construction Manager
 10. Mechanical Subcontractor
 11. Dates tests were performed
 12. Certification
 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.

3.6. TEST REPORT FORMS

- A. Heating and Cooling-Coil Test Forms - Record the following items on each test form:
1. Manufacturer, location, service.
 2. All design and manufacturer's rated data.
 3. Wet-bulb and dry-bulb temperatures entering and leaving each cooling coil; dry-bulb temperatures entering and leaving each heating coil.
 4. Air flow (Design and Actual).
 5. For DX-coil, provide design and actual saturated suction temperature.
 6. For DX-Coil, provide design and actual discharge pressures.
- B. 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. Thermal overload settings
- C. Ductless Unit Test Forms:
1. Manufacturer
 2. Type, air conditioning, heat pump
 3. Identification number
 4. Location
 5. All design and manufacturer's rated data.
 6. Rated and actual entering and leaving dry bulb temperatures.
 7. Rated and actual entering and leaving wet bulb temperatures.
 8. Air flow (design and actual)
 9. Provide actual saturated suction temperature.
 10. Actual operating current, voltage and brake horsepower of each fan motor.
 11. Final fan RPM.
 12. For Air Cooled Variable Refrigerant Volume System test current, voltage, RPM, and breaker horsepower for outdoor unit.

END OF SECTION

DIVISION 23 SECTION 23 07 01
HVAC INSULATION

TABLE OF CONTENTS

PART 1 - GENERAL

- 1.1 REFERENCE
- 1.2 DESCRIPTION
- 1.3 SCOPE
- 1.4 STANDARDS
- 1.5 SYSTEM PERFORMANCE
- 1.6 QUALITY ASSURANCE
- 1.7 DELIVERY AND STORAGE OF MATERIALS

PART 2 - PRODUCTS

- 2.1 GENERAL
- 2.2 PIPE INSULATION MATERIALS
- 2.3 PIPING INSULATION THICKNESSES SCHEDULE
- 2.4 ACCESSORY MATERIAL
- 2.5 FIELD-APPLIED JACKETS
- 2.6 HANGER BLOCKS

PART 3 - EXECUTION

- 3.1 WORKMANSHIP
- 3.2 SITE INSPECTION
- 3.3 PREPARATION
- 3.4 INSTALLATION
- 3.5 FIELD QUALITY ASSURANCE
- 3.6 PROTECTION
- 3.7 SAFETY PRECAUTIONS
- 3.8 INSULATION COVERING

SECTION 23 07 01 - 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, *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 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 585, "Recommended Practice for Inner and Outer Diameters of Rigid Pipe Insulation for Nominal Sizes of Pipe and Tubing (NPS System)".
 - d). ASTM C 1136, "Standard Specification for Barrier Material, Vapor, "Type 1 or 2 (Jacket only)".
 - e). ASHRAE 90.1 "Energy efficient design of new buildings except low-rise residential buildings", 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
- 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.

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 jacket. Pipe insulation shall be fiberglass SSL II with double closure system as manufactured by Owens Corning, Johns Manville, Knauf or approved equal.
- B. Exterior refrigerant pipe insulation shall be Armacell, or approved equal, foam insulation with exterior field applied aluminum jacketing. Interior refrigerant piping shall be Armacell or approved equal foam insulation. Where interior refrigerant piping is exposed also install field applied PVC jacketing.
- C. 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 Benjamin Foster adhesive. Jacket and butt strips shall be off-white color and shall be equivalent to Owens-Corning Fiberglass 25-ASJ.
- 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. Apply a skin coat of insulating cement to produce a smooth surface. After cement is dry, apply a light coat of fitting mastic, UL labeled, Type C, for cold water piping. Wrap fitting with fiberglass reinforcing cloth overlapping adjoining sections of pipe insulation by 2-inches. Apply a second coat of Type C mastic over the reinforcing cloth, working it to a smooth finish. As an option to the above fittings, a polyvinyl chloride fitting cover may be supplied.
- 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. For piping located outside of the building, an corrugated aluminum weatherproof jacketing system shall be provided. This system shall be Micro-Lot ML as manufactured by Manville, Polyweld by Pabco Metals Corp., Childers, or as approved equal, and installed per the manufacturer's recommendations. Where outdoor piping is receiving electric heat tape, the insulation shall be oversized so that the heat tape is not compressed tightly to the pipe. Pipe jacketing shall be corrugated (3/16-inch) deep aluminum, .016-inch thickness of H-14 temper with aluminum strapping of .75-inch width and .020 inch thickness with moisture barrier. Aluminum jacketing elbows shall be smooth, .016-inch thickness and 1100 alloy. All jacketing shall have an integrally bonded moisture barrier over the entire surface in contact with the insulation. Longitudinal joints shall be applied so they will shed water and shall be sealed completely. Circumferential joints shall be closed using preformed butt strips following manufacturer's recommendations for securement. Jacket seams shall be located on the bottom side of the horizontal piping.
- H. On cold systems such as refrigerant piping, cooling coil drain piping, etc... vapor barrier performance is extremely important. All penetrations of the ASJ and exposed ends of insulation must be sealed with vapor barrier mastic. The ASJ must be protected with either a mastic 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.
- 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 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. 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.
 3. 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.
 4. 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
All Drain Piping from Cooling Coils/Evaporators	1-inch thickness
All Refrigerant Piping	1 ½ -inch thickness

2.4. 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."

2.5. 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: White high gloss.
 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.

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 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 on piping subsequent to installation of heat tracing, painting, testing, and acceptance tests.
 - c). 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.
 - d). 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 facing.

- e). 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). Insulation cement equal in thickness to the adjoining insulation.
 - c). 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.

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 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.
- B. Exposed areas include, but are not limited to piping exposed in an occupied space.
- C. 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.
- D. Exterior exposed pipe insulation required to be insulated shall be jacketed with a corrugated aluminum jacketing system as previously described.

END OF SECTION

DIVISION 23
SECTION 23 09 00
AUTOMATIC TEMPERATURE CONTROL

TABLE OF CONTENTS

PART 1 GENERAL

- 1.1 SUMMARY
- 1.2 QUALITY ASSURANCE
- 1.3 GUARANTEE AND INSTRUCTION
- 1.4 SUBMITTALS
- 1.5 ALTERNATES

PART 2 PRODUCTS

- 2.1 WIRING
- 2.2 CONTROLLERS
- 2.3 MISCELLANEOUS ELECTRICAL DEVICES
- 2.4 TEMPERATURE SENSORS
- 2.5 MISCELLANEOUS DEVICES

PART 3 EXECUTION

- 3.1 GENERAL
- 3.2 INSTALLATION AND SUPERVISION
- 3.3 EXAMINATION
- 3.4 INTERLOCK REQUIREMENTS
- 3.5 SUBMITTALS FOR REVIEW
- 3.6 SUBMITTALS AT PROJECT CLOSEOUT

PART 4 SEQUENCES OF OPERATION

- 4.1 VARIABLE REFRIGERANT VOLUME SPLIT SYSTEM AIR COOLED SYSTEMS

SECTION 23 09 00 - AUTOMATIC TEMPERATURE CONTROL

PART 1 GENERAL

1.1 SUMMARY

- A. For General Mechanical Requirements, see Division 23 Section, *Common Work Results for HVAC*, and Division 01, *General Requirements*.
- B. Comply with all code requirements and fire safety requirements as specified in Division 21 Section, *Common Work Results for Fire Protection*.
- C. 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 ductless units, fans, switches, dampers, etc., shall be furnished and installed under this section. All electrical work shall conform to the applicable requirements of Division 26. All control wiring shall be installed in conduit in accordance with Division 26.
- D. Reference is hereby made for this contractor to become familiar with Division 26 of these specifications. Familiarization is for coordination purposes only. The contractor shall provide all necessary relays, contactors, interlock wiring etc. not provided under Division 26 for the automation of the control systems as required by the sequence of operation. The mechanical contractor shall provide all additional devices and interlock wiring required for the automation of the ATC system.
- E. Furnish all labor, materials, equipment and services necessary for and incidental to furnishing and installing a complete stand-alone, automatic control system to meet the requirements of the sequence of operation described in Part 4.
- F. All labor, material, and equipment 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.

1.2 QUALITY ASSURANCE

- A. The systems shall be complete in all respects, and shall be installed by skilled personnel. The Mechanical 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.
- B. All electrical wiring in connection with the Automatic Temperature Control System shall be furnished and installed by the Mechanical Contractor.
- C. 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.
- D. Identify each item, mounted on the face of a control panel, with an engraved nameplate

(1/4") inch high engraved letters minimum). Identify each item of control equipment (except room sensors and thermostats), with stamped tape, firmly attached to equipment (1/4") inch high letters minimum).

- E. Thermostats or sensors mounted on outside walls shall be mounted on 1 inch minimum thickness, rigid fiberglass insulating base (or equal).

1.3 GUARANTEE AND INSTRUCTION

- A. The control system including all components, 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 Mechanical Contractor shall regulate and adjust all thermostats, 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 Mechanical Contractor 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.
- B. The mechanical contractor shall completely check out, calibrate and test all equipment to insure that the system performs in accordance with the approved specifications and sequences of operation submitted.
- C. Upon completion of the work, the Mechanical 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) four (4) hour day. All training shall be by the Mechanical Contractor and shall utilize specified manuals and as-built documentation.

1.4 SUBMITTALS

- A. Submit complete shop drawings, including component catalog cuts, for approval before starting any control work. Shop drawings shall be in accordance with Division 23 Section, *Common Work Results for HVAC*. Shop drawings shall indicate all control equipment, arrangements, locations, functions, and description of operation.
- B. Upon completion of his work, the Control Contractor shall provide three (3) sets of description of operation and schematic drawings corrected to the as-built condition. This material shall be delivered to the Owner.
- C. Submittal shall consist of:
 - 1. Data sheets of all products.
 - 2. Wiring and piping interconnection diagrams including panel and device power and sources.
 - 3. Equipment lists of all proposed devices and equipment.
 - 4. Sequences of operation.

1.5 ALTERNATES

- A. Refer to Division 01 Section, “Alternates” for description of work under this section affected by alternates.

PART 2 PRODUCTS

2.1 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% 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.
- B. 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 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.
- C. All wiring shall be installed in a designated conduit raceway. The conduit shall conform to Division 26.
- D. All junction boxes shall have covers painted *safety green*, and be rigid steel.

2.2 CONTROLLERS

- A. All room thermostats shall be mounted 5'-3 inches above the furnished floor, except in stairways, corridors and toilets, which shall be 7'-0 inches. Provide insulating bases where thermostats are located on exterior or unconditioned walls. Each thermostat shall have adjustable limit stops and adjustable sensitivity. Provide vandal proof locking covers.
- B. Relays and switches shall be provided as necessary to accomplish the sequence of control specified herein. Relays shall be die cast metal selected for the required application.

2.3 MISCELLANEOUS ELECTRICAL DEVICES

- A. Unless otherwise specified, for low voltage circuits, use NFPA 70 Type T, TF, TW, THW, THWN, R, RH, RF-2, or FF-2 of 20 gauge and larger except low voltage dc and electronic circuits carrying less than 0.5 amperes cables 2 of 2 or more conductors, not smaller than 22 gauge if not shielded, may be used in lieu of individual wires. Use shielded cables carrying circuits sensitive to external fields. Terminate cables in push-on, solder or screw type terminal strips. Do not tap cables at intermediate points. Do not create intermediate junction points.
- B. Provide E.M.T. raceway systems for all wiring in accordance with NFPA 70, and Electrical Specification, Division 26. Wiring shall be plenum rated in areas of mechanical air transfer.
- C. Relays shall be open contact, mercury tube or electronic type with dust-proof enclosures

having capacity suitable for the load controlled.

- D. Operate electric and electronic mechanical controls at maximum of 120 volts or less. Where not provided under Division 26, Electrical, provide voltage transformers and isolating relays where control system must operate at voltage other than that of line voltage.
- E. Wiring shall be performed in accordance with the applicable provision of Division 26, Electrical Work. All temperature control wiring shall be run in E.M.T. in mechanical spaces in raceway and in accordance with Division 26. Furnish plenum rated cable in all areas of mechanical air transfer.
- F. Low voltage cable may be utilized in accessible locations. This cable shall be run *open* and ty-wrapped accordingly.

PART 3 EXECUTION

3.1 GENERAL

- A. The Automatic Temperature Control System shall be designed, installed, and commissioned in a turn key fully implemented and operational manner.

3.2 INSTALLATION & SUPERVISION

- A. All wiring shall be properly supported and run in a neat and workmanlike manner. All wiring 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 Mechanical 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 #18 AWG minimum THHN and shielded if required.
- C. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
- D. Install in accordance with manufacturers instructions.
- E. Check and verify location of thermostats, and other exposed control sensors with plans and room details before installation. Align with lighting switches.

3.3 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. Verify that field end devices, wiring, and tubing is installed prior to installation proceeding.

3.4 INTERLOCK REQUIREMENTS

- A. Furnish and install all necessary relays, transformer, contactors, wiring, conduit, and accessories to perform fan and equipment interlocks.

3.5 SUBMITTALS FOR REVIEW

- A. Shop Drawings: Indicate mechanical system controlled and control system components.
 - 1. Label with settings, adjustable range of control and limits. Include written description of control sequence.
 - 2. Include flow diagrams for each control system, graphically depicting control logic.

3.6 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.

PART 4 SEQUENCES OF OPERATION

4.1 VARIABLE REFRIGERANT VOLUME SPLIT SYSTEM AIR COOLED SYSTEMS

- A. The variable refrigerant volume split system shall be provided with factory furnished controls as indicated in Division 23 Section, *Heating, Ventilation, and Air Conditioning*.
- B. Under this Division install all factory furnished controls, communication wiring, interlock wiring, sensors, thermostats, and control wiring for a complete and operational system.
- C. Refer to point list on Contract Drawings for additional monitoring requirements to be provided under alternate.
- D. ATC Subcontractor shall interlock the A/C condensate float switch to their respective ductless split system indoor unit. The A/C condensate float switch shall be wired to de-

energize the indoor unit if moisture is detected in the auxiliary drain pan. A remote alarm shall be annunciated upon activation of the float switch, through the ATC system.

- E. Provide occupied and unoccupied scheduling that will allow the variable refrigerant volume split system to be de-energized during unoccupied periods. During unoccupied periods the variable refrigerant volume split system shall only be energized if any unoccupied or setback temperature is not met. Once the unoccupied or setback temperatures are met in all zones the variable refrigerant volume split system shall be de-energized.
- F. Under base bid, do not interlock VRV system controller with existing Metasys System. VRV system controller shall be fully standalone type under the base-bid. Under alternate interlock VRV system with existing Metasys System and record, trend, and monitor all information available on the VRV system controller.

END OF SECTION

DIVISION 23
SECTION 23 81 26
VARIABLE REFRIGERANT VOLUME SPLIT SYSTEM HEAT PUMP
TABLE OF CONTENTS

PART 1. GENERAL

- 1.1. RELATED DOCUMENTS
- 1.2. SUMMARY
- 1.3. SUBMITTALS
- 1.4. SYSTEM DESCRIPTION
- 1.5. QUALITY ASSURANCE
- 1.6. DELIVERY, STORAGE AND HANDLING
- 1.7. WARRANTY
- 1.8. ALTERNATES

PART 2. PRODUCTS

- 2.1. MANUFACTURERS
- 2.2. OUTDOOR UNITS – AIR COOLED
- 2.3. INDOOR UNITS
- 2.4. CONTROL SYSTEM

PART 3. EXECUTION

- 3.1. EXAMINATION
- 3.2. INSTALLATION
- 3.3. CONNECTIONS
- 3.4. COMMISSIONING AND MANUFACTURER'S FIELD SERVICES
- 3.5. DEMONSTRATION

SECTION 23 81 26 - VARIABLE REFRIGERANT VOLUME SPLIT SYSTEM HEAT PUMP

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 Variable Refrigerant Volume Split Systems.
- B. Related Sections include the following:
 - 1. Division 23 Section *HVAC Piping, Fittings and Valves* for refrigerant piping materials.
 - 2. Division 23 Section *HVAC Insulation* for refrigerant pipe insulation requirements.
 - 3. Division 23 Section, *Vibration Controls for HVAC and Plumbing* for isolation materials.
 - 4. Division 23 Section, *Automatic Temperature Control* for temperature-control devices, and control wiring and control devices connected to indoor, outdoor and refrigerant distribution devices.
 - 5. Division 26 Section, *Disconnect Switches & Circuit Breakers* and circuit breakers for field installed disconnect switches.

1.3. SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each model indicated, including rated capacities of selected model clearly indicated; dimensions; required clearances; shipping, installed, and operating weights; furnished specialties; accessories; and installation and startup instructions.
- B. Product data for Variable Refrigerant Volume units specified, including the following:
 - 1. Dimension and plans and elevation drawings including field piping, required clearances and locations of all field connections.
 - 2. Certified fan-sound power ratings.
 - 3. Certified coil-performance rating with system operating conditions indicated.
 - 4. Motor ratings and electrical characteristics plus motor and fan accessories.
 - 5. Filters with performance characteristics.
 - 6. Outdoor air cooled heat pump unit.
 - 7. Summary of all auxiliary utility requirements such as electricity, refrigerant piping, Summary shall indicate quality and quantity of each required utility.
 - 8. Refnets.
 - 9. ARHI 1230 Certification
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Detail mounting and securing to concrete pads for grade mounted systems.

1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
- D. Field Test Reports: Indicate results of manufacturer's startup and testing requirements. Submit copies of checklists.
- E. Maintenance Data: For equipment to include in the maintenance manuals specified in Division 01.
- F. Warranties: Special warranties specified in this Section.

1.4. SYSTEM DESCRIPTION

- A. Furnish and install where indicated, a variable capacity, heat pump air conditioning system. System shall be a Variable Refrigerant Volume Series split system as manufactured by Daikin, Sanyo, Samsung, Mitsubishi, or LG. The system shall consist of multiple indoor units capable of cooling or heating, refrigerant joints to separate refrigerant flow between units and headers (refnets), refrigeration distribution system using PID control, and an outdoor unit. The indoor units shall be connected to the outdoor units utilizing the specialized piping joints provided by the equipment manufacturer. The outdoor unit is a direct expansion (DX), air-cooled heat pump, multi-zone air-conditioning system with variable speed inverter driven compressor using R-410A refrigerant. The outdoor unit may connect to a connected indoor capacity up to 130% of the outdoor unit capacity. All indoor units are each capable of operating separately with individual temperature control.
- B. Operation of the system shall permit either cooling or heating of all indoor units. Each indoor unit or group of indoor units shall be able to provide set temperature independently via a space thermostat. However, all systems shall be in either heating mode or cooling mode.
- C. Manufacturer shall have five years prior experience making similar equipment as described in this specification.

1.5. QUALITY ASSURANCE

- A. All equipment and systems shall be tested and certified in accordance with AHRI 1230 (Performance Rates of Variable Refrigerant Flow (VRV) Multi-Split Air Conditioning and Heat Pump Equipment) and bear the AHRI Certification Seal.
- B. Fabricate and label refrigeration system to comply with ASHRAE 15, *Safety Code for Mechanical Refrigeration*.
- C. Listing and Labeling: Provide electrically operated components 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.

- D. Comply with NFPA 70 for components and installation.
- E. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and bear the Listed Mark.
- F. The system shall be factory tested for safety and function.
- G. Coordination: Coordinate layout and installation of indoor units, outdoor units, refrigerant piping, refnets, and other appurtenances with piping and ductwork and with other installations.

1.6. DELIVERY, STORAGE, AND HANDLING

- A. Deliver outdoor and indoor units as factory assembled units with protective crating and covering.
- B. Coordinate delivery of units in sufficient time to allow movement into building as indicated.

1.7. WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: A written warranty, executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship, within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.
 - 1. Warranty Period: Compressors and Compressor Motor Contactors: Manufacturers standard, but not less than 6 years after date of Substantial Completion.

1.8. ALTERNATES

- A. Refer to Division 01 Section, "Alternates" for description of work under this section affected by alternates.

PART 2. PRODUCTS

2.1. MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 - 1. Daikin
 - 2. Sanyo
 - 3. Samsung
 - 4. LG

5. Mitsubishi

2.2. OUTDOOR UNITS – AIR COOLED

- A. The outdoor unit is designed specifically for use with variable refrigerant volume system components. The outdoor unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of scroll compressor, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports, refrigerant regulator and all components for a complete functioning system.
- B. The outdoor unit shall be modular in design and should allow for side-by-side installation with minimum spacing.
- C. The following safety devices shall be included on the outdoor unit; high pressure switch, control circuit fuses, crankcase heaters, fusible plug, low pressure switch, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
- D. Unit Cabinet: The outdoor unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-protected mild steel panels coated with a baked enamel finish.
- E. Fan: The unit shall have one or more propeller type, direct-drive fan motors that have multiple speed operation via a DC (digitally commutating) inverter. The fan shall be a horizontal or vertical discharge configuration and the motor shall have inherent protection and permanently lubricated bearings and be mounted.
- F. Heat Pump Coil: The heat pump coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure high efficiency performance. The fins are to be covered with an anti-corrosion acrylic resin and hydrophilic film and pipe plates shall be treated with powdered polyester resin for corrosion prevention.
- G. Compressor: Unit shall contain an inverter scroll compressor. Inverter scroll compressor shall be variable speed (PAM inverter) controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the heat pump unit. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read and calculated. With each reading, the compressor capacity shall be controlled to eliminate deviation from target value. Compressor shall be spring mounted to avoid the transmission of vibration.

2.3. INDOOR UNITS

- A. Ceiling Cassette Indoor Unit - The unit shall be completely factory assembled and wired. The casing shall be galvanized sheet with grey heat insulation. This unit shall fit in the ceiling and have the capability of attaching a branch supply duct as well as a fresh air duct. The evaporator fan shall be an assembly with a high performance, fan direct driven by a

single motor. The fans shall be statically and dynamically balanced and run on permanently lubricated bearings. The indoor unit shall have an adjustable air outlet system offering 4-way air flow, 3-way air flow, or 2-way air flow. The auto air swing vanes shall automatically swing up and down for uniform air distribution. Return air shall be filtered by a long-life filter to provide approximately, 2500 hours of use in a normal office environment before cleaning. The indoor unit shall be covered with a flat panel which protrudes only 1 inch below the ceiling to provide a neat and clean installation. The coils shall be of nonferrous construction with smooth plate fins bonded to copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tubes joints shall be brazed with phosphor copper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan shall extend under the coil and piping. An integral drain pan pump capable of lifting condensate 22 inches shall be provided. An integral booster heater shall not be provided to supplement the unit during the heating mode. The unit electrical power requirements shall be as scheduled on the contract drawings. Furnish each unit with condensate pan overflow safety switch.

2.4. CONTROL SYSTEM

- A. The control system shall consist of multiple microprocessors interconnected by a single non-polar two wire multiplex transmission system. Wiring shall be daisy chained from unit to unit direct. NO SPLICES. One microprocessor shall be factory wired and located within each indoor unit. It shall have the capability of sensing return air temperature and indoor coil temperature; receive and process commands from the remote controller. The microprocessor within the wall mounted remote controller shall provide automatic cooling and heating system changeover; display set point and room temperature; a 24 hour on/off timer so that automatic operation can be set on the timer at one hour intervals from one to twenty-four hours; have self-diagnostic function display; check mode for memory of most recent problem; and provide on-off and system/mode function switching. The heating system shall be controlled so that only warm air is discharged whenever the fan speed exceeds the very low (VLO) speed. Normal operation of the remote controller provides individual system control in which one remote controller and one indoor unit are installed in the same room. The control voltage between the indoor units and the outdoor unit shall be 16 volts D.C. 16 VDC shall be generated from the outdoor unit microprocessor board. The system shall be capable of automatic restart when power is restored after power interruption. System shall include twenty function self diagnostics including total hours of compressor run time. Compressor capacity shall be modulated automatically to maintain a constant suction pressure, while varying the refrigerant volume for the needs of the cooling or heating loads. Indoor units shall use PID control to control superheat.
- B. System Controller (Base Bid): Control system shall include a central controller for user interface with system. Controller shall include a Liquid Crystal Display (LCD) touch screen capable of controlling up to 10 outdoor units and 64 indoor unit groups (maximum 128 indoor units).
- C. System Controller under the base bid shall be able to control the following functions:
1. On/Off selection for each indoor unit group or zone that is defined with several indoor unit groups.
 2. Setpoint adjustment for each indoor unit group or zone.
 3. Fan speed adjustment for each indoor unit group or zone.

4. Heat/cool/fan mode selection for each indoor unit group or zone.
 5. Automatic changeover and overheat protection.
 6. Forced shutdown terminals.
 7. Priority settings for restriction of local access for start/stop, heat/cool mode and setpoint adjustment (at local remote controllers).
 8. Setpoint limitation in both heating and cooling mode.
 9. Weekly schedule with start-up and shut off times, temperature settings, and operation modes; 16 operations/each day can be set in one schedule, and 8 different schedules are available for special working days, holidays, or period of non-use.
 10. Actual time display and setting.
 11. Reset ability for malfunction codes and filter maintenance warning.
 12. Maximum 13 months back up power supply to maintain the memory.
 13. General alarm/status reported using Digital Input or Digital Input/Output units, including interlock program.
 14. Controller must be BACnet compatible.
- D. Controller shall provide control transformer for 24 VAC supply voltage for controllers as required.
- E. Under add alternate provide interface devices as required to interface to Existing Building Automation System. ATC Interface shall allow monitoring of all points indicated on the point list.
- F. Under add alternate furnish the controls with the necessary interfaces to communicate via BACnet/IP or LonWorks to a building automation system.
- G. Under add alternate all inputs and outputs on the manufacturer's controller shall be viewable via the interface.
- H. Under add alternate all set points and schedules shall be editable via the interface by the building automation system.
- I. Under add alternate in addition to standard inputs/outputs provide additional input/outputs as required to accomplish sequence of operation and items listed on point list.
- J. Under the add alternate, the manufacturer shall be responsible for assisting and participating in the integration of the equipment into the building automation system and shall provide programming, testing, verification, and on site personnel as required.

PART 3. EXECUTION

3.1. EXAMINATION

- A. Examine space for compliance with requirements for conditions affecting installation and performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2. INSTALLATION

- A. Mount indoor and outdoor units as detailed on contract drawings and according to manufacturer's written instructions.
- B. Install all interlock and control wiring between indoor units, outdoor units, thermostats, and condensate pumps.
- C. Supply initial charge of refrigerant and oil as required.
- D. Install indoor ceiling cassette on vibration isolators.
- E. Install outdoor units on concrete pads as indicated on drawings.
- F. Comb out fins on heat pump unit where deformed or bent. Replace or repair broken fins.
- G. Install condensate lift pumps, float switches, alarm, unit shut down wiring and detection block units per manufacturer's recommendations.
- H. Under base bid install system controller and interlock all indoor and outdoor units. Under the add alternate interface system controller with existing Metasys System.
- I. Install lockable caps on all outdoor unit refrigerant service valves to prevent tampering.

3.3. CONNECTIONS

- A. Drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 - 1. Liquid and suction lines must be individually insulated between the outdoor and indoor units.
 - 2. Refrigerant Piping: conform to applicable requirements of Division 23 Section, *HVAC Piping, Fittings, and Valves*. Connect to supply and return coil tappings with shutoff valve and union or flange at each connection.
 - 3. Install refrigerant piping, refnets, insulation, and control wiring as required by the manufacturer.
 - 4. Install isolation valves on both pipes at every indoor unit.
- B. Electrical: Conform to applicable requirements in Division 26 Sections.
- C. Ground equipment.
 - 1. Tighten electrical connectors and terminals 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.

3.4. COMMISSIONING AND MANUFACTURER'S FIELD SERVICES

- A. Verify that installation is as indicated and specified. Provide factory authorized start-up and training.
- B. Complete manufacturer's installation and startup checks and perform the following:

1. Inspect for visible damage to unit casing.
 2. Inspect for visible damage to compressor, air-cooled condenser coil, and fans.
 3. Verify that clearances have been provided for servicing.
 4. Check that labels are clearly visible.
 5. Clean condenser and inspect for construction debris.
 6. Verify that controls are connected and operable.
 7. Verify that filters are installed.
 8. Adjust vibration isolators.
- C. Start unit according to manufacturer's written instructions.
1. Complete startup sheets and attach copy with Contractor's startup report.
 2. Start-up units in close coordination with testing/balancing.
- D. Check and record performance of interlocks and protection devices; verify sequences.
- E. Operate unit for an initial period as recommended or required by manufacturer.
- F. Calibrate thermostats and humidity sensors.
- G. Check internal isolators.
- H. Start refrigeration and measure and record the following:
1. Coil leaving-air, dry- and wet-bulb temperatures.
 2. Coil entering-air, dry- and wet-bulb temperatures.
 3. Refrigerant suction/discharge pressures.
 4. Indoor and outdoor unit amperage, voltage, and watts.
 5. Fan Rotation and RPM.
- 3.5. DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
1. Review data in the maintenance manuals. Refer to Division 01 Section, *Contract Closeout*.
 2. Review data in the maintenance manuals. Refer to Division 01 Section, *Operation and Maintenance Data*.
 3. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

END OF SECTION

DIVISION 26
SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL
TABLE OF CONTENTS

PART 1 GENERAL

- 1.1. RELATED DOCUMENTS
- 1.2. SUMMARY
- 1.3. PERMITS AND FEES
- 1.4. EXAMINATION OF SITE
- 1.5. INTERPRETATION OF DOCUMENTS
- 1.6. MATERIALS AND EQUIPMENT
- 1.7. ELECTRICAL WORK UNDER OTHER DIVISIONS
- 1.8. FIRE SAFE MATERIALS
- 1.9. REFERENCED STANDARDS, CODES, AND SPECIFICATIONS
- 1.10. SUBMITTALS
- 1.11. SUBMITTALS, REVIEW, AND ACCEPTANCE
- 1.12. SHOP DRAWINGS
- 1.13. DEFINITIONS
- 1.14. RECORD DRAWINGS
- 1.15. WARRANTY
- 1.16. OPERATIONS AND MAINTENANCE MANUALS
- 1.17. INSTALLATION AND COORDINATION DRAWINGS

PART 2 PRODUCTS

- 2.1. SLEEVES FOR RACEWAYS AND CABLES
- 2.2. SLEEVE SEALS
- 2.3. GROUT

PART 3 EXECUTION

- 3.1. COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION
- 3.2. SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS
- 3.3. SLEEVE SEAL INSTALLATION
- 3.4. FIRESTOPPING
- 3.5. SUPPORTS, HANGERS, AND FOUNDATIONS
- 3.6. PROVISIONS FOR ACCESS
- 3.7. PAINTING AND FINISHES
- 3.8. COLOR SELECTION
- 3.9. PROTECTION OF WORK
- 3.10. OPERATION OF EQUIPMENT
- 3.11. TESTING AND ADJUSTMENT
- 3.12. WALL AND FLOOR PENETRATIONS
- 3.13. EQUIPMENT BY OTHERS
- 3.14. PHASING
- 3.15. OUTAGES
- 3.16. CUTTING AND PATCHING
- 3.17. PENETRATION OF WATERPROOF CONSTRUCTION
- 3.18. CONNECTIONS AND ALTERATIONS TO EXISTING WORK

- 3.19. COORDINATION
- 3.20. DEMOLITION
- 3.21. EXCAVATION AND BACKFILLING

CANNOT BE USED FOR BIDDING

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 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Foam Duct Sealant.
5. Grout.
6. 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. 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.

- 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 26 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.

- H. Arrange conduit, wiring, equipment, and other work generally as shown, providing proper clearances and access. Carefully examine all Contract Drawings and fit the work in each location without substantial alteration. 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 hereinafter specified. The right is reserved to make

reasonable changes in location of equipment, conduit and wiring up to the time of rough-in or fabrication.

1.3 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 Division 01 Section, *General Requirements*.
- C. Notify Inspection Authorities to schedule inspections of work.
- D. Notify Architect in advance of scheduled inspections.
- E. An electrical foreman, superintendent or other supervisor shall be in attendance for all scheduled inspections

1.4 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.

1.5 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 above-ceiling ducts, piping, etc. Where any doubt exists, the exact location shall be determined by the Owner.
- C. All general trades and existing conditions shall be checked before installing any outlets, power wiring, etc.
- D. 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.

- E. 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.
- F. 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.
- G. Work not specifically outlined, but reasonably incidental to the completion of the work, shall be included without additional compensation from the Architect, Engineer, and Owner.
- H. 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.
- I. The complete set of Architectural, Civil, Structural, Mechanical, and Electrical Drawings and Specifications apply to this work. The successful Bidder shall familiarize himself with all other related documents.

1.6 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.

1.7 ELECTRICAL WORK UNDER OTHER DIVISIONS

A. Mechanical Equipment and Systems

1. In general, power wiring and motor starting equipment for mechanical equipment and systems are furnished and installed under Electrical Division 26.
2. Certain mechanical units are furnished from the factory with starters, contactors, transformers, fuses, wiring, etc., required for fans, pumps, etc. When this equipment is supplied from the factory, the Electrical Contractor must supply power circuit(s) to the unit and a disconnecting means. Coordinate with Mechanical Contractor so that one and only one, set of starters, fuses, switches, etc., is provided and installed.
3. In general, control and interlock equipment for HVAC systems (including associated wiring, conduit, transformers, relays, contacts, etc.) is furnished under Division 23. Division 26 shall install and connect all such equipment as necessary.
4. Controls, wiring, conduit, transformers, etc., for smoke, fire, and motor-operated dampers are provided under Division 23. Division 26 shall install and connect all such equipment.

B. Architectural Equipment: In general, any electrically operated or controlled equipment furnished under architectural divisions shall be supplied with control wiring, transformers, contacts, etc. Provide power circuits and disconnects to such equipment and install all electrical control equipment related thereto.

C. Owner Furnished Equipment: In general, Owner furnished equipment is either provided or wired by the equipment supplier. Provide power circuits to such equipment and make final connections to equipment being provided by the Owner.

D. Carefully review the Contract Documents and coordinate the electrical work under the various Divisions.

1.8 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.

1.9 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. | EPA | - | Environmental Protection Agency |
| 7. | FM | - | Factory Mutual |
| 8. | IBC | - | International Building Code |
| 9. | IEEE | - | Institute of Electrical and Electronics Engineers |
| 10. | NEC | - | National Electrical Code |

- 11. NECA - National Electrical Contractors Association
- 12. NEMA - National Electrical Manufacturers Association
- 13. NFPA - National Fire Protection Association
- 14. OSHA - Occupational Safety and Health Act
- 15. UL - Underwriters' Laboratories

- B. The application standards of the local electric utility company.
- C. 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.

1.10 SUBMITTALS

- A. Product Data: For items specified in Part 2 of this Section.

1.11 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 Architect, to be in best interest of Owner.
- B. 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. 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.

1.12 SHOP DRAWINGS

- A. Prepare and submit Shop Drawings for all electrical 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 Product 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.

Items and Systems

1. Ballasts for Lighting Fixtures
2. Battery Packs for Lighting Fixtures
3. Conductors and Cables - 600V or Less
4. Conduit and Raceway
5. Disconnect (Safety) Switches - Fused/Non-Fused
6. Equipment Nameplates/Labels
7. Firestopping Materials
8. Foam Duct Sealant
9. Fuses, 600V or Less
10. Grout
11. Hangers and Supports
12. Identification Products
13. Junction and Pull Boxes, Standard Sizes
14. Lamps
15. Lighting Fixtures, Exterior
16. Lighting Fixtures, Interior
17. Operation and Maintenance Manual
18. Outlet and Device Boxes
19. Receptacles
20. Record Drawings
21. Toggle/Snap Switches
22. Wiring Diagrams

- D. 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.
- E. Submit for approval any other shop drawings as required by the Architect, 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.
- 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 for any reason.
- G. 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.

1.13 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, embedded in construction or attic.
- 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 porches, etc...) commercial kitchens, and vehicle washing areas.
- 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.

1.14 RECORD DRAWINGS

- A. Upon completion of the electrical installations, the Contractor shall deliver to the Architect 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 Architect.

1.15 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.

1.16 OPERATIONS AND MAINTENANCE MANUALS

- A. The Contractor shall have prepared six(6) copies of the Operations 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: *Operations and Maintenance Manual – JP Court 3/17 Lobby Renovations and Additions - 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. Provide divider tabs and table of contents for organizing and separating information.
- C. 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. Maintenance operation and lubrication instructions on each piece of equipment furnished.
 3. Complete catalog data on each piece of electrical equipment furnished including approved Shop Drawing/Submittal with Engineer's Comments (if any).
 4. Manufacturer's extended limited warranties on equipment.
 5. Provide sales and authorized service representatives names, address, and phone numbers of all equipment and subcontractors.
 6. Provide supplier and subcontractor's names, address, and phone number.
 7. Catalog data of all equipment, starters, etc. shall include wiring diagrams, parts list and assembly drawing.
 8. Approved Electrical Certificates.
- D. Submit Operations and Maintenance Manual prior to anticipated date of Substantial Completion for Engineer review and approval. Substantial Completion requires that Operations and Maintenance Manuals be reviewed and approved.
- E. Deliver all instruction materials to the Owner prior to the formal instruction period.
- F. Upon completion of all work, thoroughly instruct the Owner's representatives in the proper operation and maintenance of all electrical equipment and systems.
- G. Instructions shall be done only after completed systems have been put into operation and tested for proper operation and performance.
- H. 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.
- I. Furnish the necessary technicians, skilled workers, and helpers to operate the electrical systems and equipment of the entire project for one 8-hour day.

- J. Where specified in technical sections, provide longer periods required for specialized equipment.
- K. Instruct the Owner or designated personnel in operation, maintenance, lubrication, and adjustment of systems and equipment.
- L. The Operations and Maintenance Manual shall be available at the time of the instructions, for use by Instructors and Owner personnel.
- M. Schedule the general and specialized instruction periods for a time agreed upon by the Owner and Engineer.

1.17 INSTALLATION AND COORDINATION DRAWINGS

- A. Prepare, submit and use composite installation and coordination drawings to assure proper coordination and installation of the work.
- B. Draw plans to a scale not less than ¼ inch equals one foot. Include plans, sections and elevations of the proposed work, showing all equipment (mechanical, plumbing and electrical), conduit and wiring in the areas involved. Fully dimension all work, horizontally and vertically. Show coordination with other work including piping, ductwork and other mechanical work, walls, doors, ceilings, columns, beams, joists and other architectural and structural work.
- C. Identify all equipment and devices on wiring diagrams. Where field connections are shown to factory-wired terminals, furnish manufacturer's literature showing internal wiring of equipment.
- D. Prepare scaled coordination drawings in accordance with the Specifications. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
 - 1. Indicate the proposed locations of power, lighting, and all special system raceways, equipment, and materials. Include the following:
 - a. Working space and dedicated space clearances per the NEC.
 - b. Clearances for equipment disassembly required for periodic maintenance.
 - c. Exterior wall and foundation penetrations.
 - d. Fire-rated wall and floor penetrations.
 - e. Equipment connections and support details.
 - 2. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
 - 3. The successful Bidder shall be responsible for indicating all raceways described in notes or indicated by home run symbols.
 - 4. The successful Bidder shall check all trades' Drawings, including Civil, Architectural, Structural, Plumbing, and Mechanical, to avoid possible demolition and installation conflicts.

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.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Bridgeport Fittings, Inc.
 - c. Calpico, Inc.
 - d. GS Metals Corporation
 - e. Metraflex Co.
 - f. O-Z/Gedney
 - g. Pipeline Seal and Insulator, Inc.
 - h. Raco, Inc.
 - 2. Sealing Elements: EPDM, or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant 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 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 2008 NEC Article 110.26.
- 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 service requirements for each piece of equipment receiving electrical connections. Provide proper service for each.
- 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. Right of Way: Give to piping systems installed at a required slope.
- J. Coordinate electrical work with architectural items and equipment by others. Typical equipment refers to, but is not limited to, the following:
 - 1. Countertops, Casework and Cabinets.
 - a. Do not install outlets, switches, etc., behind casework, cabinets, etc.
 - b. Data, phone, and other low voltage system outlets shall be mounted above the counter tops to match power outlets in the same areas.
 - c. Coordinate counter top outlets with drilling of casework/counters.
 - d. Coordinate surface raceways and outlets above and below counters with approved casework shop drawings to avoid conflicts with sinks and other appurtenances.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, or wireways 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. Install sleeves during erection of slabs and walls.

- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. 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.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors **2 inches (50 mm)** above finished floor level.
- G. Size pipe sleeves to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. 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. Comply with requirements of Division 07 Section "Joint Sealants."
- 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 "Penetration Firestopping" and Division 26 Section "Electrical Firestopping".
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for **1-inch (25-mm)** annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for **1-inch (25-mm)** annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals. Seal interior of each raceway with Foam Duct Sealant as specified herein.
- N. Cut sleeves to length for mounting flush with both surfaces of walls.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 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 26 Section, "Electrical 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.

3.6 PROVISIONS FOR ACCESS

- A. The Contractor shall provide access panels and doors for all concealed equipment, and other devices requiring maintenance, service, adjustment 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. 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
 - 3. Masonry or Dry Wall: Style M
- C. Where access is by means of liftout ceiling tiles or panels, mark each ceiling grid using small color-coded and numbered tabs. Provide a chart or index for identification. Place markers within ceiling grid not on ceiling tiles.
- D. 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.
- E. 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.
- F. Provide sufficient access and working space for repair and maintenance about all lighting and electrical equipment to permit ready and safe operation and maintenance of such equipment OSHA 29 CFR 1910 Subpart D and 1910.303(g).

3.7 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, ductwork, piping 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 Architect, unless otherwise indicated by the Architect.
- H. All exposed conduit, equipment, etc. in finished spaces shall be painted. Colors shall be as selected by the Architect and conform to ANSI Standards.

3.8 COLOR SELECTION

- A. Color of finishes shall be as selected by the Architect.

3.9 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.

3.10 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. Do not use electrical systems for temporary services or during construction, unless approved by Owner in writing. Refer to Division 01 Section "Temporary Facilities and Controls".
- E. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items.

3.11 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 Architect/Engineer for approval.

3.12 WALL AND FLOOR PENETRATIONS

- A. All penetrations of partitions, ceilings, roofs and floors by conduit under Division 26 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 26.
- 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 26 Section, "Electrical Firestopping".
- C. Where penetrating through exterior walls or below grade, provide waterproof pipe penetration seals, as specified in another division of these Specifications.
- D. Provide conduit escutcheons for all exposed conduit penetrations in finished interior spaces and all exposed exterior penetrations. Escutcheons shall match those provided under Division 23.
- E. 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.

3.13 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.

3.14 PHASING

- A. Refer to Architectural 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 (AHJ).
- 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. 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 Architect 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 and Architect can be aware of the areas of construction and progress as it relates to the approved schedule.
- F. 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.

3.15 OUTAGES

- A. Provide a minimum of fourteen (14) 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.

3.16 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.
- B. Do not cut structural members without approval from the Architect or Engineer.

3.17 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.
- B. Where conduits penetrate roofs, flash pipe with Stoneman *Stormtite*, Pate or approved equal, roof flashing assemblies with skirt and caulked counter flashing sleeve.
- C. Furnish and install pitch pockets or weather tight curb assemblies where required.
- D. Furnish and install curbs, vent assemblies, and 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, the National Roofing Contractors Association, SMACNA, and as required by other divisions of these Specifications.

3.18 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.

3.19 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, and wireways 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 2008 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 location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified herein.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 26 Section "Electrical Firestopping".

3.20 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, 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 State Fire Marshal, the Owner and the Authorities 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. 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.
- N. 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.
- O. The Owner shall have the first right of refusal for all fixtures, devices and equipment removed by the Contractor.
- P. 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.
- Q. 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.
- R. 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.
- S. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.
- T. Terminate services and utilities in accordance with local laws, ordinances, rules and regulations.

3.21 EXCAVATION AND BACKFILLING

- A. General:
 - 1. Perform all necessary excavation, or installation of work under Division 26, in

whatever materials or conditions encountered, using suitable methods and equipment.

2. Accurately establish required lines and grades and properly locate the work.
3. Determine the locations of all existing utilities before commencing the work.

B. Excavation: (Refer also to other portions of the Specifications)

1. Excavate only the required elevations. If excavation is carried below the foundation lines or other required limits, backfill the excess with concrete.
2. Keep banks of trenches as nearly vertical as possible, and provide sheeting and/or shoring as required for protection of work and safety of personnel. Follow local, State, and OSHA Guidelines.
3. Keep excavations dry. Protect excavations from freezing.

C. Backfilling: (Refer also to other portions of the Specifications)

1. Backfill excavations to the required elevations and restore surfaces to their original or required conditions.
2. Backfill shall be similar material, free from objectionable matter such as rubbish, roots, stumps, brush, rocks and other sharp objects. Unless otherwise indicated, suitable material from the excavation may be used for backfill.
3. Carefully place and mechanically tamp backfill in layers not exceeding 12 inches loose thickness. Compact to 95 percent minimum.
4. Do not backfill against frozen material. Do not use frozen material for backfill.

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: _____

DIVISION 26
SECTION 26 05 19
CONDUCTORS AND CABLES
TABLE OF CONTENTS

PART 1 GENERAL

- 1.1 RELATED DOCUMENTS
- 1.2 SUMMARY
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
- 1.5 DELIVERY, STORAGE AND HANDLING
- 1.6 COORDINATION
- 1.7 PROJECT CONDITIONS

PART 2 PRODUCTS

- 2.1 MANUFACTURERS
- 2.2 BUILDING WIRES AND CABLES
- 2.3 CONNECTORS AND SPLICES
- 2.4 METAL CLAD (MC) CABLE AND CONNECTORS
- 2.5 INSULATING TAPE, PUTTY, RESIN AND SUPPORTS

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 PREPARATION
- 3.3 WIRE AND INSULATION APPLICATIONS
- 3.4 INSTALLATION
- 3.5 CONNECTIONS
- 3.6 IDENTIFICATION
- 3.7 FIELD QUALITY CONTROL

SECTION 26 05 19 - 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. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Indicate procedures and values obtained.
- B. Product Data: Provide for each cable assembly type, wire, cables, conductors, and connectors.
- C. Factory Test Reports: Indicate procedures and values obtained.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.
- E. Project Record Documents: Record actual locations of components and circuits.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: In addition to requirements specified in Division 01 Section *Quality Control*, 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 the National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3 of this Section.
- B. 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.
- C. Comply with NEMA/Insulated Cable Engineers Association (ICEA) Standards.

- D. Comply with NECA Standard of Installation.
- E. Comply with NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- F. American Society for Testing and Materials (ASTM): Comply with requirements of the following:
1. B1: Standard Specification for Hard-Drawn Copper Wire
 2. B2: Standard Specification for Medium-Hard-Drawn Copper Wire
 3. B3: Standard Specification for Soft or Annealed Copper Wire
 4. B8: Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
 5. D753: Standard Specification for General Purpose Polychloroprene Jacket for Wire and Cable
- G. Electrical Testing Laboratories (ETL): Provide wiring, cabling and connector products which are ETL listed and labeled.
- H. 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
- I. NFPA: Comply with NFPA 70 requirements for construction, installation and color coding of electrical wire, cable and connections.
- J. National Electrical Manufacturer's Association (NEMA): Comply with requirements of the following:
1. WC3: Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
 2. WC5: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
- K. 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
- L. 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, *Wire and Cable Packaging*.
- 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 and Architect.
- 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. Conductor sizes are based on copper.
- C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.
- D. 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.; Leviton Manufacturing Co.
 - b. BICC Brand-Rex Company.
 - c. Carol Cable Co., Inc.

- d. Senator Wire & Cable Company.
 - e. Southwire Company.
 - f. Colonial Wire Company
2. Connectors and Accessories for Wires and Cables:
- a. AMP Incorporated.
 - b. Buchanan.
 - c. General Signal; O-Z/Gedney Unit.
 - d. Monogram Company; AFC.
 - e. NSI Industries, Inc.
 - f. Square D Company; Anderson.
 - g. 3M Company; Electrical Products Division.
3. Metal Clad (MC) Cable
- a. Alcan Cable
 - b. Atkore AFC Cable Systems
 - c. Encore Wire Corporation
 - d. General Cable
 - e. Nexans
 - f. Prysmian Cables and Systems
 - g. Service Wire Company
 - h. Southwire Company
 - i. United Copper Industries

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 No. 10 AWG and smaller, and stranded for No. 8 AWG and larger.
- E. 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. 120/240-Volt, 1-Phase, 3-Wire System:
 - a. Phase A: Black
 - b. Phase B: Red
 - c. Neutral: White
 - d. Ground: Green
- F. Rubber insulation material shall comply with NEMA WC 3.
- G. Thermoplastic insulation material shall comply with NEMA WC 5.
- H. Cross-Linked Polyethylene insulation material shall comply with NEMA WC 7.
- I. Ethylene Propylene Rubber insulation material shall comply with NEMA WC 8.

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: Solderless spring type pressure connector with insulating covers for copper wire splices and taps. Use for conductor sizes 10 AWG and smaller.
- E. All wire connectors used in underground or exterior pull boxes shall be gel-filled twist connectors or a connector designed for damp and wet locations.
- F. Mechanical Connectors: Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled cable entrances.

- G. 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.
- H. 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*.
- I. 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.
- J. Wire Nut Connectors:
 - 1. Wire nuts installed in wet locations, exterior, etc., shall be self-contained, waterproof and corrosion-proof units incorporating prefilled silicone grease to block out moisture and air.
 - 2. Connectors shall be UL listed and appropriately sized according to manufacturer's recommendation for the suitable wire sizes and voltage rating (600 volt minimum).
 - 3. Connector body shall have a color-coded outer shell.
 - 4. Connectors shall be as manufactured by King Technology or approved equal.

2.4 METAL CLAD (MC) CABLE AND CONNECTORS

- A. Cable shall meet or exceed the requirements of UL Standard 83, UL Standard 1063, and UL Standard 1569 for Type MC cable, Federal Specification A-A59544 Vertical Cable Tray Flame Test and the National Electrical Code. Cable shall be listed for use in UL 1, 2, and 3 Hour Through-Penetration Firestop Systems.
- B. Cable shall be constructed with soft drawn copper, 600 volt, type THHN/THWN conductors rated 90°C dry/75°C wet, with a green insulated grounding conductor. Only cables with conductor sizes 12 AWG and 10 AWG shall be permitted. Conductors shall be cabled together with a binder tape bearing a print legend that is wrapped around the assembly. An aluminum interlocked armor shall be applied over the assembly. Conductors shall be protected by an anti-short bushing at each termination.
- C. Straight connectors shall be one-piece spring-steel, set screw design with nylon insulator. Provide cable Lok XC-73 series, as manufactured by Steel City, or approved equal.
- D. 90°C connectors shall be die cast zinc, clamp type with insulated throat. Provide XC-89 series as manufactured by Steel City, or approved equal.

2.5 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 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.
 - 1. Wiring shall be tagged at terminations, in pull boxes, junction boxes, outlet boxes, panelboards, handholes, etc...
- C. Switch leg wire shall be labeled with "S" tag.
- D. All control wiring shall be color coded with wires of colors different from those used to designate phase wires.

- E. 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'	-	#12	0-100'	-	#12
60 – 100'	-	#10	100 & Up	-	#10
100' & Up	-	#8			

- F. 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.
- G. 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.
- H. Joints of #8 AWG and larger in power and lighting circuits 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.
- I. Branch circuits for lighting and power concealed above accessible/suspended ceilings and in drywall partitions may be accomplished by utilizing type MC (metal clad) cable. Cables shall be supported with appropriate hangers. Tie wire will not be accepted.
- J. All circuits for exterior electric work shall be #10 AWG (minimum) and contain an extra #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, *Common Work Results for Electrical* and Division 26 Section, *Hangers and Supports*.
- G. Seal around cables penetrating fire-rated elements according to Division 26 Section *Electrical Firestopping*.
- H. Identify wires and cables according to Division 26 Section, *Electrical Identification*.
- I. Conductors installed in parallel shall be of equal lengths.
- J. Wiring at Outlets: Install with at least 12 inches (300 mm) of slack conductor at each outlet.
- 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 feeder cable shall be labeled at terminals and at all accessible points in equipment and in pull boxes. Each control wire shall be labeled at both ends. Labels shall be self-sticking wire markers.
- N. Riser cables shall have cable supports as required by Code.
- O. For rubber and plastic-covered wire and cable, pulling compound Ideal Yellow 77 may be used.
- P. 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 #4/0 AWG and smaller. Two-hole lugs for all sizes #250 kcmil AWG and larger.
- Q. Install wires and cables using braided rope larger than the cable being pulled to keep twists to a minimum.

- R. Provide an insulated green equipment grounding conductor (EGC), sized per NEC, for all feeder and branch circuits, shown or not shown.
- 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 type AVA.
- V. No conductors shall be drawn into conduit until all work, which may cause cable damage, is completed.
- W. All wiring in fluorescent fixture channels and in other high ambient temperature areas, shall be of types required by NEC.
- 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. All cable runs shall contain S loops or other means to accommodate expansion or contraction as required. Cable bends will have a radius not less than the value recommended by the cable manufacturer. Cable connected to electronic equipment in the system shall be tagged to show its function and the location of its other end. 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. Use oxide inhibitor in each splice and tap connector for aluminum conductors.
- E. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.
- F. 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.
- G. Wire splices and taps shall be adequate to carry full current rating of wire.
- H. Splices and taps in wires up to #8 AWG shall be made with *Scotch-lok* or T&B PT Series or Ideal Wing Nut insulated electrical connectors. Wire nuts installed in wet location boxes

shall be silicon gel-filled. For wires #8 AWG and larger, use copper solderless connectors covered with insulating molded body and then wrapped with electrical tape. Use twist-on wire connectors for connecting lighting fixtures and small motor leads up to #8 AWG wire.

- I. 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.
- J. 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.
- K. For splices in branch circuits and feeders, provide connectors as follows;
 - 1. Wire Sizes #14 AWG to #10 AWG: Provide Ideal Model 74B or 76B or equivalent by T&B.
 - 2. Wire Sizes #8 AWG and Larger: Provide Ideal Model Series AGP and GT or equivalent by Burndy, O-Z, or T&B. All splices shall be enclosed in insulating molded thermoplastic, rubber, or rubber-like covers or shall be wrapped with Bishop No. 111 or equivalent insulating tape in accordance with the Manufacturer's directions.
- L. Thoroughly clean wiring prior to installing lugs or connectors.

3.6 IDENTIFICATION

- A. Interface with Other Work:
 - 1. Identify wire and cable using Thomas and Betts Type WM vinyl markers.
 - 2. 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.
- B. Provide identification tags on each conductor entering each panelboard, switch, junction box, and pull box to identify conductor.
- C. Comply with the requirements of Division 26 Section, *Electrical Identification*.
- D. 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.
 - 2. If suspended type tags are provided, they shall be attached by approximately 55-pound test monofilament line or slip-free plastic cable lacing units.

3.7 FIELD QUALITY CONTROL

- A. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.2. Certify compliance with test parameters.
- B. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.
- C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
- D. Verify continuity of each branch circuit conductor.
- E. Tests: All wire and cable and branch circuit insulation shall be tested after installation, and before connection to fixtures and appliance.
1. Tests shall be performed with a 1,000-volt megger, and conductors shall test free from short-circuits and grounds.
 2. Conductors shall be tested phase-to-phase and phase-to-ground.
 3. Furnish the instruments, materials, and labor required. Perform the tests in the presence of the Contracting Officer.
 4. Actual test readings shall be recorded.
 5. Submit all test reports to the Architect for approval.
- F. Demonstration: Subsequent to wire and cable hook-ups, energize circuit and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION

DIVISION 26
SECTION 26 05 26
GROUNDING AND BONDING
TABLE OF CONTENTS

PART 1. GENERAL

- 1.1. RELATED DOCUMENTS
- 1.2. SUMMARY
- 1.3. SUBMITTALS
- 1.4. QUALITY ASSURANCE
- 1.5. PROJECT RECORD DOCUMENTS

PART 2. PRODUCTS

- 2.1. MANUFACTURERS
- 2.2. GROUNDING AND BONDING PRODUCTS
- 2.3. WIRE AND CABLE GROUNDING CONDUCTORS
- 2.4. MISCELLANEOUS CONDUCTORS
- 2.5. CONNECTOR PRODUCTS

PART 3. EXECUTION

- 3.1. APPLICATION
- 3.2. INSTALLATION
- 3.3. CONNECTIONS

SECTION 26 05 26– GROUNDING AND BONDING

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 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 each separately-derived system neutral to nearest grounding system.
- C. 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 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 conductors, connectors and connection materials, and grounding fittings. Submit ground system manufacturer's recommended installation procedure for review.
- C. Field tests and observation reports certified by the testing organization and indicating and interpreting the test reports for compliance with performance requirements.

1.4 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. Heary Brothers Lightning Protection Co.
 3. Ideal Industries, Inc.
 4. ILSCO.
 5. O-Z/Gedney Co.
 6. Raco, Inc.
 7. 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 “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 2008 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 2008 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 ally 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.

- C. Exothermic Connections: Provide exothermic-weld kit selected per manufacturer's written instructions for specific types, sizes, and combinations of conductors and connected items.

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. Lighting branch circuits.
 - c. Receptacle branch circuits.
 - d. Single-phase motor or appliance branch circuits.
 - e. Flexible raceway runs.
 - f. Metal-clad cable (MC) runs.
 - 2. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- B. Separately Derived Systems: Where NEC requires grounding, ground according to NEC Article 250-26.
- C. Metal Poles Supporting Outdoor Lighting Fixtures: Ground pole to a grounding electrode in addition to separate equipment grounding conductor run with supply branch circuit.

3.2 INSTALLATION

- A. General: Ground electrical systems and equipment according to NEC requirements, except where Drawings or Specifications exceed NEC requirements.
- B. 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.
- C. 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.
- D. 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.

- E. 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.
- F. 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 No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- 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

CANNOT BE USED FOR BIDDING

DIVISION 26
SECTION 26 05 28
ELECTRICAL FIRESTOPPING
TABLE OF CONTENTS

PART 1 GENERAL

- 1.1 RELATED DOCUMENTS
- 1.2 SUMMARY
- 1.3 REFERENCES
- 1.4 DEFINITIONS
- 1.5 SYSTEM DESCRIPTION
- 1.6 SUBMITTALS
- 1.7 QUALITY ASSURANCE
- 1.8 DELIVERY, STORAGE AND HANDLING
- 1.9 PROJECT CONDITIONS
- 1.10 GUARANTEE

PART 2 PRODUCTS

- 2.1 MANUFACTURERS
- 2.2 THROUGH-PENETRATION FIRESTOPPING OF FIRE-RATED CONSTRUCTION
- 2.3 SMOKE-STOPPING AT SMOKE PARTITIONS
- 2.4 ACCESSORIES

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 PREPARATION
- 3.3 INSTALLATION
- 3.4 FIELD QUALITY CONTROL
- 3.5 ADJUSTING AND CLEANING
- 3.6 SYSTEMS AND APPLICATION SCHEDULES

SECTION 26 05 28 - ELECTRICAL FIRESTOPPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Through-penetration firestopping in fire rated construction.
 - 2. Through-penetration smoke-stopping in smoke partitions.
- B. Related items: Raceway seals and manufactured electrical devices: Refer to Division 26 Section, "Raceways and Boxes".

1.3 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: ASTM E 814-88: Standard Test Method for Fire Tests of Through-Penetration Firestops.

1.4 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.

1.5 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, connections with other surfaces or types of construction, at separations required to permit building movement and sound or vibration absorption.
2. Smoke barrier construction: Maintain barrier and structural floor resistance to cold smoke at all penetrations, connections with other surfaces and types of construction and at all separations required to permit building movement and sound or vibration absorption.

1.6 SUBMITTALS

- A. Submit in accordance with Division 01, 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: Statement of qualifications.
- E. Applicators' qualifications statement: List past projects indicating required experience.

1.7 QUALITY ASSURANCE

- A. Installer's qualifications: Firm 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.
- D. Manufacturer shall be a member of the International Firestop Council (IFC).

1.8 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.

1.9 PROJECT CONDITIONS

- A. Existing conditions:
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.

1.10 GUARANTEE

- A. Submit copies of written guarantee agreeing to repair or replace joint sealers which fall 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 guarantee period shall be two years from date of substantial completion unless otherwise noted.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1. Hilti.
 - 2. 3M
 - 3. Nelson.

2.2 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, penetrate 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 of this Section.
 - b. All firestopping products must be from a single manufacturer.

2.3 SMOKE-STOPPING AT SMOKE PARTITIONS

- A. Through-penetration smoke-stopping: Any system complying with the requirements for through-penetration firestopping in fire-rated construction, as specified in "The Systems and Applications Schedule" in Part 3 of this Section, is acceptable, provided that the system includes the specified smoke seal or will provide a smoke seal. The length of time of the fire resistance may be disregarded.

2.4 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.
- C. Sleeves: Minimum 24 MSG galvanized steel, 12-inch diameter or smaller steel pipe. Sleeve shall project ½-inch from each surface of the floor/wall. Size as recommended by firestop manufacturer.

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.

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 conduits, cable tray, or other items, close unused portions of opening with firestopping materials tested for the application.
- E. Install smoke stopping as specified for firestopping.
- F. Provide sleeves the full thickness of the assembly being penetrated and cut sleeves to a length of 1-inch more than the over-all thickness of the penetration, or as recommended by the firestop manufacturer.

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.

3.5 ADJUSTING AND CLEANING

- A. Clean up spills of liquid components.
- B. Neatly cut and trim materials as required.
- C. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

3.6 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 CP 25WB+ 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 MPS-2+ 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+	WL2002 FS-195+, PPD'S WL2003 FS-195+ WL2004 FS-195+	FC2002 FS-195+, PPD'S FC2007 FS-195+, PPD'S FC2008 FS-195+

PENETRATING ITEM	CONCRETE	GYPSUM	WOOD FLOOR/CEILING
	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	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	FC2009 FS-195+, PPD'S FC2024 FS-195+ FC2026 FS-195+ FC2028 FS-195+, 1' & 2-inch WIDE, PPD'S
Insulated Cable	CAJ3001 CP 25N/S, CP 25S/L CAJ3005 CS 195+, FS-195+ CAJ3007 2001 CAJ3009 2000, 2000+, 2003 CAJ3010 2000, 2000+, 2003 CAJ3011 2001 CAJ3014 FD 150 CAJ3015 FD 150 CAJ3021 MPS-2+ CAJ3029 2000, 2000+, 2003 CAJ3030 CP 25WB+ CAJ3031 CP 25N/S, CP 25S/L CAJ3041 2000, 2000+, 2003 CAJ3044 CS-195+, FS-195+ CAJ3058 FS-195+, MPS-2+ CAJ3071 CP 25N/S, CP 25S/L CAJ3074 CP 25N/S, CP 25S/L CAJ3075 2001 CAJ3080 CP 25WB+ CBJ3016 CS-195+, FS-195+ CBJ3017 CS-195+, MPS-2+ FA3001 CP 25WB+ FB3004 CS-195+, MP WJ3015 2001 WJ3016 2001	WL3001 CP 25, MPS-2+ WL3008 2000+ WL3009 2000+ WL3015 CP 25WB+, CP 25N/S WL3022 2000+ WL3030 FS-195+ WL3031 MPS-2+ WL3032 CP 25WB+ WL3041 2000+ WL3051 CP 25N/S WL3056 CP25N/S WL3062 CP 25WB+	FC3001 CP 25S/L, CP 25N/S FC3002 2000+ FC3003 2000, 2000+, 20003 FC3007 CP 25WB+, MPS-2+ FC3008 FS-195+
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	WL8002 CS-195+, FS-195+	

PENETRATING ITEM	CONCRETE	GYPSUM	WOOD FLOOR/CEILING
	FA8001 FS-195+, CP 25WB+		

* Underwriter's Laboratories, Inc., Fire Resistance Directory.

END OF SECTION

CANNOT BE USED FOR BIDDING

DIVISION 26
SECTION 26 05 29
HANGERS AND SUPPORTS
TABLE OF CONTENTS

PART 1 GENERAL

- 1.1 RELATED DOCUMENTS
- 1.2 SUMMARY
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
- 1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING
- 1.6 GUARANTEE

PART 2 PRODUCTS

- 2.1 MANUFACTURERS
- 2.2 COATINGS
- 2.3 MANUFACTURED SUPPORTING DEVICES
- 2.4 ANCHOR METHODS

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 INSTALLATION
- 3.3 CLEANUP
- 3.4 PROTECTION

SECTION 26 05 29 – HANGERS AND SUPPORTS

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 Division 26 Sections apply to this Section:
 - 1. “Common Work Results for Electrical” for general installation requirements.
 - 2. “Electrical Firestopping” for requirements for firestopping at sleeves through walls and floors that are fire barriers.

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 cradles, 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.
- C. Submit for review, shop/assembly drawings and layout drawings of equipment supports for major items of equipment.
- D. Submit structural calculations for approval. Calculations include stress and deflection analysis. Submit design criteria and selection calculation.
- E. Supporting devices and fastening methods shall be subject to the review and approval of the Structural Engineer.

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 - August 19, 1986 Edition, December 11, 1989 Addendum.
 - 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. Coating: 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 shall be hot-dip galvanized.

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 holes at a minimum of eight inches on center in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacturer.

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.
 4. **Concrete (New):** Iron or steel inserts. Expander type anchors, specified for existing may be used provided concrete is clear of conduit for drilled depth.
 5. **Concrete (Existing):** Double-plated expander type anchors. Phillips, Hilti, or approved equivalent. Loads shall not exceed 1/4 of tested pullout (or shear) strength.

6. Precast Concrete Plank: Drill hole through plank; bolt hanger rod to 4" x 4" x 1/8" steel plate on top of plank.
- I. Tests: Test pull-out resistance of one of each type, size, and anchorage material for the following fastener types:
 1. Expansion anchors.
 2. Toggle bolts.
 3. Power-driven threaded studs.
 - J. Provide all jacks, jigs, fixtures, and calibrated indicating scales required for reliable testing. Obtain the structural Engineer's approval before transmitting loads to the structure. Test to 90 percent of rated proof load for fastener. If fastening fails test, revise all similar fastener installations and retest until satisfactory results are achieved.
 - K. 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 (conduit and EMT) 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
 5. Provide additional hangers or steel members to distribute the load among two or more structural members when required or directed.
 6. Drilling of new concrete slabs will not be permitted. Anchors and inserts shall be cast in the concrete slabs.
 - L. 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.

M. 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. No electrical items shall rest on, or depend for support on suspended ceiling media (tiles, lath, plaster, splines, etc.).
4. In suspended ceilings, support conduits directly from structural slabs, decks (or framing members). Do not support conduits on ceiling suspension members.
5. Support surface or pendant lighting fixtures:
 - a. From an outlet box by means of an interposed metal strap, where weight is less than 5 lbs.
 - b. From an outlet box by means of a hickey or other direct threaded connection, where weight is from 5 to 50 lbs.
 - c. Directly from structural slab, deck or framing member, where weight exceeds 50 lbs.
6. In addition to the above, provide cushioned, swivel type hangers with appropriate outlet boxes for pendant fixtures in mechanical areas. Such hangers shall have a support rating at least twice that of the load supported.

7. Support recessed lighting fixtures directly from structural slab, deck, or framing members. Refer to Division 26 Section “Interior Lighting” for additional installation requirements.
8. 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.
9. 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.
10. Hangers and supports shall be hot dipped galvanized, unless noted otherwise.
11. Equipment shall not be held in place by its own dead weight. Provide base anchor fasteners in each case.
12. 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.
13. Vertical conduits shall be supported by heavy wrought iron clamps or collars anchored to construction at each floor.

N. 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.

O. TABLE I: SPACING FOR RACEWAY SUPPORTS

TABLE 1: SPACING FOR RACEWAY SUPPORTS			
Raceway Size (Inches)	No. of Conductors in Run	Location	EMT (Ft.)
		HORIZONTAL RUNS	
1/2, 3/4	1 or 2	Flat ceiling or wall.	5

TABLE 1: SPACING FOR RACEWAY SUPPORTS			
Raceway Size (Inches)	No. of Conductors in Run	Location	EMT (Ft.)
		HORIZONTAL RUNS	
1/2, 3/4	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	7
1/2, 3/4	3 or more	Any location.	7
1/2 - 1	3 or more	Any location.	
1 & larger	1 or 2	Flat ceiling or wall.	6
1 & larger	1 or more	Where it is difficult to provide supports except at intervals fixed by the building construction.	10
1 & larger	3 or more	Any location.	10
Any	---	Concealed.	10
		VERTICAL RUNS	
1/2, 3/4	---	Exposed.	7
1, 1-1/4	---	Exposed.	8
1-1/2 & larger	---	Exposed.	10
Up to 2	---	Shaftway.	10
2-1/2	---	Shaftway.	10
3 & larger	---	Shaftway.	10
Any	---	Concealed.	10
Abbreviations:	EMT	Electrical Metallic Tubing	

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.

END OF SECTION

CANNOT BE USED FOR BIDDING

DIVISION 26
SECTION 26 05 33
RACEWAYS AND BOXES
TABLE OF CONTENTS

PART 1 GENERAL

- 1.1 RELATED DOCUMENTS
- 1.2 SUMMARY
- 1.3 DEFINITIONS
- 1.4 SUBMITTALS
- 1.5 QUALITY ASSURANCE
- 1.6 COORDINATION
- 1.7 PROJECT RECORD DOCUMENTS

PART 2 PRODUCTS

- 2.1 MANUFACTURERS
- 2.2 METAL CONDUIT AND TUBING
- 2.3 NONMETALLIC CONDUIT AND TUBING
- 2.4 METAL WIREWAYS
- 2.5 OUTLET AND DEVICE BOXES
- 2.6 FLOOR BOXES
- 2.7 PULL AND JUNCTION BOXES
- 2.8 BOX EXTENSIONS
- 2.9 EXPANSION / DEFLECTION FITTINGS
- 2.10 BUSHINGS

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 RACEWAY REQUIREMENTS
- 3.3 INSTALLATION
- 3.4 FLEXIBLE CONNECTIONS
- 3.5 INSTALLATION OF TERMINATIONS
- 3.6 INSTALLATION OF BOXES
- 3.7 PROTECTION
- 3.8 CLEANING

SECTION 26 05 33 - RACEWAYS AND BOXES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

- 1. Raceways include the following:

- a. EMT.
- b. ENT.
- c. FMC.
- d. IMC.
- e. LFMC.
- f. LFNC.
- g. PVC.
- h. RGS.
- i. RMC.
- j. RNC

- k. Wireways.

- 2. Boxes, enclosures, and cabinets include the following:

- a. Device boxes.
- b. Floor boxes.
- c. Outlet boxes.
- d. Pull and junction boxes.
- e. Cabinets and hinged-cover enclosures.

- 3. Miscellaneous Products include the following:

- a. Expansion/Deflection fittings.
 - b. Bushings.
- B. Related Sections include the following:
- 1. Division 26 Section “Electrical Firestopping” for requirements for firestopping at penetrations through walls and floors that are fire barriers.
 - 2. Division 26 Section “Hangers and Supports” for raceways and box supports.
 - 3. Division 26 Section “Wiring Devices” for devices installed in boxes and for floor-box service fittings.

1.3 DEFINITIONS

- A. EMT: Electrical Metallic Tubing.
- B. ENT: Electrical Nonmetallic Tubing.
- C. FMC: Flexible Metal Conduit.
- D. IMC: Intermediate Metal Conduit.
- E. LFMC: Liquidtight Flexible Metal Conduit.
- F. LFNC: Liquidtight Flexible Nonmetallic Conduit.
- G. PVC: Rigid Polyvinyl Chloride Conduit.
- H. RGS: Rigid Galvanized Steel Conduit.
- I. RMC: Rigid Metal Conduit.
- J. RNC: Rigid Nonmetallic Conduit.

1.4 SUBMITTALS

- A. Product Data: For raceways, wireways and fittings, floor boxes, 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 installation of outlet boxes, mounting heights, orientation, and locations of outlets.

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 Co.
2. Nonmetallic Conduit and Tubing:
- a. Anamet, Inc.; Anaconda Metal Hose.
 - b. Arco Corp.
 - c. Breeze-Illinois, Inc.
 - d. Cantex Industries; Harsco Corp.
 - e. Certainteed Corp.; Pipe & Plastics Group.
 - f. Cole-Flex Corp.
 - g. Condux International; Electrical Products.
 - h. Electri-Flex Co.
 - i. George-Ingraham Corp.
 - j. Hubbell, Inc.; Raco, Inc.
 - k. Lamson & Sessions; Carlon Electrical Products.
 - l. R&G Sloan Manufacturing Co., Inc.
 - m. Spiraduct, Inc.
 - n. Thomas & Betts Corp.
3. 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. O-Z/Gedney; Unit of General Signal.
 - g. Scott Fetzer Co.; Adalet-PLM.
 - h. Spring City Electrical Manufacturing Co.
 - i. Thomas & Betts Corporation.
4. Metal Wireways:
- a. Hoffman Engineering Co.
 - b. Keystone/Rees, Inc.
 - c. Square D Co.
5. Nonmetallic Wireways:
- a. Hoffman Engineering Co.
 - b. Lamson & Sessions; Carlon Electrical Products.
 - c. Wiremold Co.
 - d. Hubbell
6. 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. O-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.

7. Floor Boxes:

- a. Crouse Hinds.
- b. Hubbell.
- c. Wiremold.

2.2 METAL CONDUIT AND TUBING

- A. Rigid Galvanized Steel Conduit: ANSI C80.1 and UL 6.
- B. IMC: ANSI C80.6.
- C. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.
- D. Plastic-Coated IMC and Fittings: NEMA RN 1.
- E. EMT and Fittings: ANSI C80.3, galvanized tubing.
 - 1. Fittings: Compression type, NEMA FB1.
- F. FMC: Zinc-coated steel.
- G. LFMC: Flexible steel conduit with PVC jacket.
- H. Fittings: NEMA FB 1; compatible with conduit/tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

- A. ENT: NEMA TC 13.
- B. PVC: NEMA TC 2, Schedule 40 or 80.
- C. ENT and PVC Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.

- D. LFNC: UL 1660.

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: Manufacturer's standard enamel finish.

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 FLOOR BOXES

- A. Floor Boxes: Cast iron for at-grade or basement levels and formed steel at all above grade levels unless otherwise noted on the drawings, fully adjustable, rectangular with internal tunnel compartment. All boxes and covers shall be UL listed for protection against scrub water. Provide close up plugs and reducing bushings as required.

2.7 PULL AND JUNCTION BOXES

- A. Small Sheet Metal Boxes: NEMA OS 1.
- 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.

2.8 BOX EXTENSIONS

- A. Prohibited on new construction.
- B. 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.

2.9 EXPANSION / DEFLECTION FITTINGS

- A. Provide an expansion/deflection fitting in each concealed or exposed electrical run crossing a building expansion joint. Fittings shall be complete with bronze end couplings, neoprene sleeves, tinned copper braid integral bonding jumper and stainless steel bands. Expansion/deflection fittings shall be suitable for the size and type of conduit run they connect. Bonding jumper shall comply with NEC and UL requirements.
- B. Expansion/deflection fitting shall accommodate the following movements without collapsing or fracturing the conduit and damaging the wires it contains:
 - 1. Axial expansion or contraction up to 3/4-inch.
 - 2. Angular misalignment of the axes of the conduits up to 30 degrees in all directions.
 - 3. Parallel misalignment of the axes of the conduits up to 3/4-inch in all directions.
- C. Expansion/Deflection fitting shall be OZ/Gedney Type "DX" or approved equal by Crouse Hinds (Type XD).

2.10 BUSHINGS

- A. Bushings for 1-inch conduit and smaller shall be self-extinguishing thermoplastic type - 150°C temperature rating.
- B. Bushings for 1-1/4" conduit and larger shall be malleable iron body with 150 degrees C insulating ring. Insulating material shall be locked in place and non-removable.

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 REQUIREMENTS

- A. Conduit Application Schedule:

Application	Conduit Type	Remarks
In or under concrete slab	RGS	
Exposed exterior locations.	RGS	Use threaded or rain-tight fittings.

Wet interior locations.	RGS	Use threaded or rain-tight fittings.
Exposed dry interior locations up to 7'-0" AFF.	RGS	
Exposed dry interior locations above 7'-0" AFF.	EMT	
Exterior Underground	RNC (Sched. 40 PVC)	RGS Elbows/Sweeps
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.
Equipment connections in exterior locations.	LFMC (e.g. Sealtite)	Short lengths only (maximum 6 feet). Use threaded or rain-tight fittings.
Concealed in dry wall construction.	EMT, IMC, RGS, MC Cabling	
Concealed above suspended ceilings.	EMT, IMC, RGS, MC Cabling	
Concealed in masonry walls.	EMT	

1. Provide hot-dip Rigid Galvanized Steel Conduit (RGS) for embedded interior work in concrete.
2. Provide hot-dip Rigid Galvanized Steel Conduit (RGS), galvanized Intermediate Metal Conduit (IMC) or galvanized Electrical Metallic Tubing (EMT) for concealed work above suspended ceilings and within interior partitions and for exposed interior work above 7'-0". Maximum EMT size permitted is two inches.
3. Provide Flexible Metal Conduit (FMC), e.g. Greenfield, in short lengths (maximum 6 feet) for the connection of lighting fixtures, and any vibrating equipment in dry interior locations. The flexible connections to recessed fixtures and equipment shall be sufficient slack to permit removal of fixture.
4. Provide Liquidtight Flexible Metal Conduit (LFMC), e.g. Sealtite, in short lengths (maximum 6 feet) for the connection of exterior equipment, motors and equipment in damp or wet locations as defined in Division 26 Section "Common Work Results for Electrical".
5. Provide hot-dip Rigid Galvanized Steel Conduit (RGS) with bonded PVC jacket (Plastic-Bond or Kor-Kap) for work not completely encased in concrete but laid directly in or in contact with ground or on a vapor barrier and additionally, as directed.
6. Aluminum conduit is prohibited.
7. Where indicated on the drawings, Rigid Non-metallic Conduit may be used as permitted in Article 352 of the NEC, with or without concrete encasement. Where rigid non-metallic conduit is exposed, it shall be Schedule 40 PVC, with all provisions for thermal expansion/contraction as recommended by the Manufacturer.

8. 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 plastic, Type II.
9. Conduits shall slope from entrance equipment toward outside of building.

B. 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 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 "Concretight" or "Raintight" compression fittings made from galvanized steel or malleable iron. 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 in conduits exposed to weather, in wet locations, in underground locations, and in slabs.

C. 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.
3. Provide cast box (with threaded hubs) in exterior enclosures, and high traffic areas (surface installations), as specified by Owner.

D. Outlet Boxes:

1. Outlet boxes for concealed work shall be zinc-coated or cadmium-plated sheet steel boxes suitable for the service and type outlet. Boxes and conduit fittings for outdoor and exposed work shall be NEMA 4 cast-aluminum, cast steel or cast iron type with threaded hubs for conduit entrance. Boxes and conduit fittings for outdoor work shall have gasketed cover plates. Extra large boxes shall be provided in accordance with the National Electrical Code where necessary to prevent crowding of wire in the box. Plastic boxes and cast "white metal" boxes classified as NEMA 4 will not be acceptable.
2. Outlet boxes in unplastered brick or block walls shall be provided with deep square-cut device covers. They shall be set so that the brick or block can be cut and fitted closely to the cover opening and so that the standard wall plate will cover the joint between the brick or block and the box.
3. All outlet boxes used for supporting fixtures shall be furnished with malleable iron fixture studs of "no-bolt" type secured by locknut. Provide support for boxes occurring in suspended ceilings. Outlets in ceilings directly on bottom of joists shall be supported independent of ceiling construction. Outlets in suspended ceilings shall not be supported from ceiling construction.
4. All boxes, whether outlet, junction, pull, or equipment, shall be furnished with appropriate covers.
5. No sectionalized boxes shall be used.
6. Back-to-back outlet boxes are not permitted. Separate boxes a minimum of 6" in standard walls and a minimum of 2 feet in acoustical walls.
7. Provide knockout closures for unused openings.
8. Provide blank coverplates for all unused boxes.
9. For multiple device installations, provide multi-gang boxes. Sectional boxes are not permitted. Provide barrier separation of different voltage conductors in the same box.
10. Thoroughly coordinate mounting heights of boxes with casework and backsplash heights.

11. Provide recessed outlet boxes in finished areas, supported from interior partition studs. Supports are to be stamped steel stud bridges for hollow stud walls and adjustable steel channel fasteners for flush ceiling outlet boxes.
 12. Provide back supports for boxes in metal stud walls.
- E. 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

- 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:

Fire Alarm System
Lighting
Power 120/240 volt

1. All raceway systems shall be completely wired as specified herein, shown on drawings and/or required for satisfactory operation of the various systems.
2. 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.
3. Underground conduits for services outside of building and entrance into building shall be as specified herein.

4. 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.
- C. Minimum Raceway Size: 3/4-inch trade size (DN21).
 - D. Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors.
 - E. Electrical Metallic Tubing (EMT) shall be used for the following unless otherwise indicated:
 1. Branch circuits for lighting, receptacles, and power concealed in:
 - a. Dry wall construction.
 - b. Suspended ceilings.
 - 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. Suspended ceilings.
 - F. 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.
 - G. Telephone, data, public address, ATC (Automatic Temperature Control), and Fire Alarm system wiring shall be installed in raceways within partitions, terminated 8" above ceiling.
 - H. Wiring above ceiling shall be plenum rated cable, where required by Code.
 - I. Wiring installed concealed above hard ceilings and exposed in areas with no ceilings shall be installed in conduit.
 - J. 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.

- K. 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.
- L. 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.
- M. Install raceways level and square and at proper elevations. Provide adequate headroom.
- N. Complete raceway installation before starting conductor installation.
- O. Support raceways as specified in Division 26 Section "Hangers and Supports". Arrange supports to prevent misalignment during wiring installation.
- P. 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.
- Q. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab. Conduit stub-ups and stub-downs shall be arranged in a neat and orderly manner and shall emerge at right angles to floors or ceilings.
- R. 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.
- S. 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.
- T. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.
- U. Conduits may be installed in grade level concrete floor slab with the following limitations:
1. Maximum size - 1-1/4".
 2. Minimum concrete cover – 1.0", above and below.
 3. Minimum spacing between conduits - 6" on center.
 4. Conduit outside diameter - 1/3 of slab thickness.
 5. Installed between bottom and top reinforcing, and centerline of conduit at the mid-depth of the slab.
 6. Secured to prevent possible change in position, sagging, or shifting as concrete is poured.

7. Water or damp-proofing integrity of slab is not disturbed.
- V. Conduits larger than 1-1/4" may be installed in concrete floor slabs only with the specific permission of the Engineer, or as specifically indicated on the drawings, all in accordance with the above limitation.
- W. Transition non-metallic tubing to rigid steel conduit before rising above the floor.
- X. Space raceways laterally to prevent voids in the concrete.
- Y. Run conduit parallel to or at right angles to main reinforcement. When at right angles to reinforcement, place conduit close to slab support.
- Z. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
- AA. Run parallel or banked raceways together, on common supports where practical.
- BB. 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.
- CC. 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.
- DD. Tighten set screws of threadless fittings with suitable tools.
- EE. Install pull wires in empty raceways. Use No. 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.
- FF. Lubricants for pulling wires shall be approved for use with the types of wire and conduit installed.
- GG. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.
- HH. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
- II. Use conduit hubs or sealing lock nuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- JJ. 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.
- KK. Avoid moisture traps; provide junction box with drain fittings at low points in conduit system.

- LL. Die-cast fittings of pot metal will not be accepted.
- MM. Surface Metal Raceway: Install a separate green ground conductor in raceway from the junction box supplying the raceway to receptacle or fixture ground terminals.
1. Select each surface metal raceway outlet box to which a lighting fixture is attached to be of sufficient diameter to provide a seat for the fixture canopy.
 2. Where a surface metal raceway is used to supply a fluorescent lighting fixture having central stem suspension with a backplate and a canopy (with or without extension ring), the backplate and canopy will serve as the outlet box and no separate outlet box need be provided.
 3. Provide surface metal raceway outlet box, in addition to the back plate and canopy, at the feed-in location of each fluorescent lighting fixture having end stem suspension.
 4. Where a surface metal raceway extension is made from an existing outlet box on which a lighting fixture is installed (provide a backplate slightly smaller than the fixture canopy), no additional surface-mounted outlet box need be installed.
- NN. Conduits shall be free of any burrs, foreign objects, and water prior to conduit installation.
- OO. 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 ½ " to ¾" conduit.
- PP. Rigid conduit or Electrical Metallic Tubing (EMT) shall not be strapped or fastened to equipment subject to vibration or mounted on shock-absorbing bases.
- QQ. Conduit shall be installed in such manner as to insure against the collection of trapped condensation, and runs of conduit shall be without traps wherever possible. Drill 1/8" diameter weep holes where necessary.
- RR. 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.
- SS. Provide wall flanges and gasketing on conduits entering fan housings to minimize air leakage at points of penetration of housing.
- TT. Conduit risers shall be rigidly supported on the building structure, using appropriate supports only.
- UU. In equipment spaces, such as fan rooms, plenums, etc., conduits and outlets may be exposed, but shall avoid interference with ventilating ducts, piping, etc.

- VV. 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.
- WW. 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.
- XX. 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.
- YY. Screws for all exposed work shall be stainless steel, unless otherwise noted.
- ZZ. Zinc coated galvanized steel screws may be used for interior dry locations only.
- AAA. No running threads shall be cut or used.
- BBB. Conduits which are installed at this time and left empty for future use and which are five feet or more in length, including all telephone and communication conduits shall have a non-ferrous, 600 lb. tensile strength drag line left in place for future use. All empty conduits including conduit stubs shall be tagged at all exposed ends with tags identifying the location of the end of the conduit.

3.4 FLEXIBLE CONNECTIONS

- A. Use maximum of six (6) feet (1830 mm) of UL listed Flexible Metal Conduit (FMC) for recessed and semi-recessed fluorescent lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use Liquidtight Flexible Metal Conduit (LFMC) in wet or damp locations, as defined per NEC. Flexible conduits shall not be used for indoor HID lighting fixture connections.
- 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.

3.5 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 No. 10 AWG or larger enter a raceway, cabinet, pull box, and junction box, the conductors shall be protected by an insulated bushing providing a smoothly rounded surface.
- E. Double lock nuts 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 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. Set floor boxes level and adjust to finished floor surface.
- C. 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.
- D. 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.)
- E. 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.
- F. Pull boxes shall be installed at all necessary points 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.
- G. 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.
- H. Pull boxes with barriers shall have a single cover plate and the barriers shall be of the same gauge as the pull box.

- I. Exposed pull boxes will not be permitted in finished spaces.
- J. Location of pull boxes shall be coordinated with piping, ductwork, and other equipment so as to permit sufficient clearance for maintenance and access.
- K. Pull boxes recessed in walls or partitions shall be provided with flanged type covers.
- L. Outlet boxes and covers shall be sheet steel knockout type, zinc-coated, or cadmium-plated and shall be of proper Code size for the number of wires of conduits passing through or terminating therein, but in no case shall any box be less than 4" square, or boxes at end of a run and containing a single device may be of the "handy box" type. Covers for flush outlets shall finish flush with plaster or other finished surface. Approved factory-made knockout seals shall be used in all boxes where knockouts are not intact. Boxes in concrete shall be a type which will allow the placing of conduit without displacing the reinforcing bars. Additional pull boxes shall be installed as required to facilitate pulling of wires.
- M. Outlet boxes for lighting fixtures shall be equipped with fixture supporting devices.
- N. Outlet boxes for switches shall be of the gang type.
- O. Each circuit in each pullbox shall be marked with a tag guide denoting panels to which they connect.
- P. Boxes shall be separated to prevent sound transmission. Back-to-back boxes shall not be used.
- Q. Outlet boxes shall be provided with suitable plaster rings and covers or plates.
- R. Unused knockout holes shall remain closed and those opened by error shall be closed with snap-in blanks.
- S. Outlet boxes shall not be smaller than required by Code for the number and size of wires to be installed.
- T. Outlet boxes installed in plenum ceilings shall be in accordance with applicable codes.
- U. 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.
- V. Outlet boxes for toggle switches and pilot lights at doorways shall be located at the strike side of the door as finally hung.
- W. 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.
- X. Install junction and pull boxes to be accessible.

- Y. Locations of junction and pull boxes requiring access panels shall be reviewed by the Owner's Representative.

3.7 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.

3.8 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, the entire run to the nearest box or other termination point shall be cleaned.

END OF SECTION

DIVISION 26
SECTION 26 05 53
ELECTRICAL IDENTIFICATION
TABLE OF CONTENTS

PART 1 GENERAL

- 1.1 RELATED DOCUMENTS
- 1.2 SUMMARY
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
- 1.5 DEFINITIONS

PART 2 PRODUCTS

- 2.1 RACEWAY AND CABLE LABELS
- 2.2 NAMEPLATES AND SIGNS
- 2.3 UNDERGROUND LINE WARNING TAPE
- 2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS

PART 3 EXECUTION

- 3.1 INSTALLATION

SECTION 26 05 53 - ELECTRICAL IDENTIFICATION

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, stenciling, 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.
- B. Schedule of Nomenclature: An index of electrical equipment and system components used in identification signs and labels. Provide a schedule of nameplates and stenciling.
- C. Samples: Prior to installation, submit samples for each type of label and sign to illustrate color, lettering style, and graphic features of identification products. These samples shall include examples of the lettering to be used. Samples shall be mounted on 8-1/2-inch x 11-inch sheets annotated, explaining their proposed use.

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.
- B. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend, overlaminated 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.
- F. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-inch- (0.4-mm-) thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.
- G. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, unless otherwise indicated, with eyelet for fastener.
- H. Aluminum-Faced, Card-Stock Tags: Weather-resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 inch (0.05 mm) thick, laminated with moisture-resistant acrylic adhesive, punched for fasteners, and preprinted with legends to suit each application.
- I. Brass or Aluminum Tags: 2 by 2 by 0.05-inch (51 by 51 by 1.3-mm) metal tags with stamped legend, punched for fastener.

2.2 NAMEPLATES AND SIGNS

- A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.45.
- B. 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.
 - b. Emergency Power System: White lettering on red background, unless otherwise required by the Authority Having Jurisdiction (AHJ).
 - 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.

- C. 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.
- D. Nameplates for Damp/Wet Interior and Exterior Locations:
1. Weather-resistant, non-fading, pre-printed, cellulose-acetate butyrate.
 2. Minimum 1/8-inch thick with 0.0396-inch (1-mm) galvanized steel backing.
- E. Refer to Contract Drawings for typical nameplate details.
- F. Refer to Paragraph "Equipment Identification Labels" under Part 3 of this Section for installation requirements.

2.3 UNDERGROUND LINE WARNING TAPE

- A. Non-biodegradable, polyethylene tape, 8 mil thick and a minimum of 6 inches wide with detectable metallic foil. Provide warning labels on 3 foot centers and be colored as follows:
1. Electrical ducts, piping or cable (600V and below) - Yellow tape with black printed labeling: CAUTION-BURIED ELECTRICAL LINE BELOW.
- B. Bury marker tape 12-inches below grade above every buried conduit.

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. Before attaching labels, clean all surfaces with the label manufacturer's recommended cleaning agent.
2. Install all labels firmly, as recommended by the label manufacturer.
3. Labels attached to receptacle faceplates shall be installed plumb and neatly on all equipment.
4. Install nameplates parallel to equipment lines.
5. Secure nameplates to equipment fronts using screws or rivets. Secure nameplate to inside of recessed panelboards in finished locations.
6. Embossed tape will not be permitted for any application.
7. Labels: All labels shall be permanent and be machine-generated. NO HANDWRITTEN OR NON-PERMANENT LABELS SHALL BE ALLOWED.
8. Label size shall be appropriate for the conductor size(s), outlet faceplate layout design. All labels to be used shall be self-laminating, white/transparent vinyl and be wrapped around the cable sheath. 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 Directories:

1. Panelboards shall be equipped with equipment nameplates as specified in paragraph "Equipment Identifications Labels" in Part 3 of this Section.
2. Panelboards shall have an accurate typed index indicating exactly what each added branch serves.
3. The Contractor shall provide up to date directories in existing panelboards, indicating all deletions and additions, and to note the date of all changes on the directory.
4. The directory 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. If at anytime after occupancy the directory is found to be incorrect due to negligence by the installer, then the Contractor shall trace out circuits, and correct the directory at no additional cost to the Owner.
- C. Miscellaneous Identification:
1. Individual enclosed switches: 1/4-inch (6 mm); identify load served.
 2. Junction boxes: 1/2-inch (13 mm); identify system source(s) and load(s) served.
- 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. Install painted identification according to manufacturer's written instructions and as follows:
1. Clean surfaces of dust, loose material, and oily films before painting.
 2. Prime surfaces using type of primer specified for surface.
 3. Apply one intermediate and one finish coat of enamel.
- I. Color Code Banding and Painting of Raceways, Boxes, and Cables: Band all exposed and concealed accessible raceways, pull boxes, and junction boxes of the systems listed below:
1. Bands: Pre-tensioned, wraparound plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches (51 mm) wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
 2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
 3. Junction boxes, pull boxes, and their covers shall be distinctively painted to identify their service.
 4. Apply the following colors to the systems listed below:
 - a. Fire Alarm System: Red.
 - b. Security System: Blue.

- c. CCTV System: Green and yellow.
 - d. Mechanical and Electrical Supervisory System: Green and blue.
 - e. Telecommunication System: Green.
 - f. 120/240 V Power and Lighting System: Yellow.
 - g. Any other system, with system type (such as *Sound System*) marked on covers in black letters with white covers.
- J. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: 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.
- K. 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.
- L. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, install continuous underground line warning tape located directly above line at 12 inches (150 to 200 mm) below finished grade. Where width of multiple lines installed in a common trench does not exceed 16 inches (400 mm) overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.
- M. Branch-Circuit Conductors: Color-code throughout the secondary electrical system. Refer to Division 26 Section “Conductors and Cables” for additional requirements.
- N. Power-Circuit and Control Wire Identification: Metal tags or aluminum, wraparound marker bands for each conductor, cables, feeders, and power circuits in panelboard gutters, outlet boxes, junction boxes, pullboxes, junction boxes, 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.
- O. Apply identification to conductors as follows:

1. Conductors to be Extended in the Future: Indicate source and circuit numbers.
 2. 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.
- P. 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.
- Q. Equipment Identification Labels: Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise noted, labels/nameplates shall identify equipment designation(s), voltage rating, and source (including source locations). Labels for disconnect switches, etc..., shall indicate the designation of the load served as the “equipment designation”. In general, labels 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 labeling examples. Apply labels to each unit of the following categories of equipment:
1. Disconnect Switches.
 2. Control Devices.
 3. Access Doors and Panels for Concealed Electrical Items.
- R. Fire Alarm: Junction box covers shall be painted red. Wiring color code shall match existing.
- S. Surfaces shall be cleaned and painted, if specified, before applying markings.
- T. Place markings so that they are visible from the floor.
- U. Protect finished identification to insure that markings are clear and legible when project is turned over to the Owner.

END OF SECTION

DIVISION 26
SECTION 26 09 23
LIGHTING CONTROL DEVICES
TABLE OF CONTENTS

PART 1 GENERAL

- 1.1 RELATED DOCUMENTS
- 1.2 SUMMARY
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
- 1.5 COORDINATION

PART 2 PRODUCTS

- 2.1 MANUFACTURERS
- 2.2 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS
- 2.3 OUTDOOR PHOTOCELL

PART 3 EXECUTION

- 3.1 INSTALLATION
- 3.2 CONTROL WIRING INSTALLATION
- 3.3 IDENTIFICATION
- 3.4 FIELD QUALITY CONTROL
- 3.5 CLEANING

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes outdoor photocells.
- B. Related Sections include the following:
 - 1. Division 26 Section “Wiring Devices” for wall-box dimmers and manual light switches.

1.3 SUBMITTALS

- A. Product Data: Include dimensions and data on features, components, and ratings for lighting control devices. Provide product data on each control device specified.
- B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- C. Shop Drawings: Indicate control device enclosure wiring diagrams and panel layout drawings.
- D. Maintenance Data: For lighting control devices to include in maintenance manuals specified in Division 01. Include instructions on adjusting, repairing, cleaning and lubricating each control device specified.
- E. Project Record Documents: Accurately record actual locations of each product and device, and indicate circuits controlled.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain lighting control devices from a single source with total responsibility for compatibility of lighting control system components specified in this Section.
- B. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA-70, Article 100, for their indicated use and installation conditions by a testing agency acceptable to authorities having jurisdiction.
- C. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.
- D. Comply with NFPA 70.
- E. Comply with NEMA ICS 2, *Industrial Control Devices, Controllers and Assemblies*.

- F. Comply with UL 773A, *Non-Industrial Photoelectric Switches for Lighting Control*.
- G. Comply with ANSI/NEMA ICS 6, *Enclosures for Industrial Controls and Systems*.

1.5 COORDINATION

- A. Coordinate features of devices specified in this Section with systems and components specified in other Sections to form an integrated system of compatible components. Match components and interconnections for optimum performance of specified functions. Include coordination with the following:
 - 1. Division 26 Section “Exterior Lighting”.

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. Photocell Control:
 - a. Area Lighting Research, Inc.
 - b. Fisher Pierce.
 - c. Intermatic, Inc.
 - d. Tork, Inc.

2.2 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

- A. Line-Voltage Surge Protection: Include in all 120- and 277-V solid-state equipment. Comply with UL 1449 and with ANSI C62.41 for Category A locations.

2.3 OUTDOOR PHOTOCELLS

- A. Description: Specification Grade photocell with the following features:
 - 1. Constructed of die-cast zinc, gasketed for weather protection.
 - 2. Cell shall be cadmium sulphide, epoxy coated, one inch diameter.
 - 3. Unit shall have a slide for earlier or later turn on.
 - 4. Delay of up to two (2) minutes to prevent false switching due to light from vehicles or lighting, etc...
 - 5. Contacts shall be normally closed and fail in the “ON” position.

6. Temperature Range: -40 degrees to +140 degrees Fahrenheit.
 7. Provided with three (3) color-coded, minimum six (6) inch long wire leads, #16 AWG, rated for 105 degrees Celsius.
 8. Photocell shall have a fixed base for mounted through 7/8 inch opening or 1/2 inch knockout.
- B. Photocell shall be TORK Model 2101, or approved equal by listed manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install equipment level and plumb and according to manufacturer's written instructions.
- B. Mount lighting control devices according to manufacturer's written instructions and requirements in Division 26 Section "Common Work Results for Electrical".
- C. Mounting heights indicated are to bottom of unit for suspended devices and to center of unit for wall-mounting devices.
- D. All products and devices shall be installed in accessible locations.
- E. Locate electrically held contactors where the eventual vibration and noise they will produce will not be objectionable to building occupants.
- F. Provide enclosures for each individual component.

3.2 CONTROL WIRING INSTALLATION

- A. Wiring Method: Install all wiring in raceway as specified in Division 26 Section "Raceways and Boxes", unless run in accessible ceiling space and gypsum board partitions.
- B. Bundle, train, and support wiring in enclosures.
- C. Ground equipment.
- D. Connections: 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.
- E. Connect control devices to systems controlled, to achieve proper system operation.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Electrical Identification".

3.4 FIELD QUALITY CONTROL

- A. Schedule visual and mechanical inspections and electrical tests with at least seven days' advance notice.
- B. Inspect control components for defects and physical damage, testing, laboratory labeling, and nameplate compliance with the Contract Documents.
- C. Check tightness of electrical connections with torque wrench calibrated within previous six months. Use manufacturer's recommended torque values.
- D. Verify settings of photoelectric devices with photometer calibrated within previous six months.
- E. Electrical Tests: Use particular caution when testing devices containing solid-state components. Perform the following according to manufacturer's written instructions:
 - 1. Continuity tests of circuits.
 - 2. Operational Tests: Set and operate devices to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions. Include testing of devices under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.
- F. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.
- G. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.
- H. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

3.5 CLEANING

- A. Cleaning: Clean equipment and devices internally and externally using methods and materials recommended by manufacturers, and repair damaged finishes.

END OF SECTION

DIVISION 26
SECTION 26 27 26
WIRING DEVICES
TABLE OF CONTENTS

PART 1 GENERAL

- 1.1 RELATED DOCUMENTS
- 1.2 SUMMARY
- 1.3 DEFINITIONS
- 1.4 SUBMITTALS
- 1.5 QUALITY ASSURANCE
- 1.6 COORDINATION

PART 2 PRODUCTS

- 2.1 MANUFACTURERS
- 2.2 STRAIGHT-BLADE RECEPTACLES
- 2.3 GFCI RECEPTACLES
- 2.4 SWITCHES
- 2.5 FINISHES
- 2.6 DEVICE PLATES
- 2.7 MULTI-SERVICE FLOOR BOXES (RECTANGULAR)

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 INSTALLATION
- 3.3 IDENTIFICATION
- 3.4 CONNECTIONS
- 3.5 FIELD QUALITY CONTROL
- 3.6 CLEANING

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 and associated device plates.
 - 2. GFCI receptacles.
 - 3. Weather-Resistant receptacles.
 - 4. Toggle switches.

1.3 DEFINITIONS

- A. EMI: Electromagnetic Interference.
- B. GFCI: Ground-Fault Circuit Interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-Frequency Interference.
- E. UTP: Unshielded Twisted Pair.
- F. WR: Weather-Resistant.

1.4 SUBMITTALS

- A. Product Data: For each product specified, indicating configurations, finishes, dimensions, and manufacturer's instructions.
- B. Shop Drawings: Legends for receptacles and switch plates.
- C. Samples: For devices and device plates for color selection and evaluation of technical features.
- D. 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 plugs 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

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

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 Div.
 - b. Pass & Seymour/Legrand; Wiring Devices Div.
 - c. Leviton Manufacturing Co., Inc.
 - d. Cooper Wiring Devices
2. Multioutlet Assemblies:
 - a. Airey-Thompson Co.
 - b. Wiremold.
 - c. Hubbell Inc. Wiring Devices
 - d. American Electric
3. Floor Service Outlets:
 - a. American Electric.
 - b. Hubbell, Inc.; Wiring Devices Div.
 - c. Pass & Seymour/Legrand; Wiring Devices Div.
 - d. Square D Company.
 - e. Wiremold.

2.2 STRAIGHT BLADE RECEPTACLES

A. General Requirements

1. Straight blade receptacles shall have the following basic features:
 - a. One-piece brass mounting strap with integral ground for low resistance of fault currents.
 - b. Auto-ground clip to assure positive ground.
 - c. Impact-resistant nylon face and thermoplastic base housing.
 - d. #10 large head brass terminal and ground screws.

B. Duplex Convenience Receptacles

1. Duplex convenience receptacles shall be extra heavy-duty, specification grade, 20A, 125V.
2. Comply with NEMA WD-1, NEMA WD-6 configuration 5-20R, UL 498 and Federal Specification W-C-596.
3. Hubbell HBL5362 or Pass & Seymour 5362A, or equal by acceptable manufacturer.

C. Special Purpose Receptacles

1. Special purpose receptacles shall have ratings and NEMA configurations as indicated on the Drawings, or as required to match equipment plug configuration, and shall be black with device plate to match outlet type.

2.3 GFCI RECEPTACLES

A. General Requirements

1. GFCI receptacles shall have the following basic features:
 - a. Solid-state ground-fault sensing and signaling.
 - b. Trip time of 0.025 seconds (nominal).
 - c. Trip threshold of +/- 5mA.
 - d. Indicator light that is lighted when device is tripped.
 - e. Auto-ground clip to assure positive ground.
 - f. Impact-resistant nylon face and thermoplastic base housing.
 - g. #10 large head brass terminal and ground screws.

B. Duplex GFCI Receptacles

1. Duplex GFCI receptacles shall be extra heavy-duty, specification grade, 20A, 125V.
2. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, UL 498 and Federal Specification W-C-596.
3. Hubbell GF20 or Pass & Seymour 2095, or equal by acceptable manufacturer.

C. Weather-Resistant Duplex GFCI Receptacles

1. Weather-resistant duplex GFCI receptacles shall be extra heavy-duty, specification grade, 20A, 125V with the following features:
 - a. "WR" marking on face as required by UL Standard.
 - b. UV-resistant nylon face for longer life under adverse environmental conditions.

2. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, UL 498 and Federal Specification W-C-596.
3. Hubbell GFTR20 or Pass & Seymour 2095TRWR, or equal by acceptable manufacturer.

2.4 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) or Pass & Seymour PS20AC1 (single-pole), PS20AC2 (two-pole), PS20AC3 (three-way), PS20AC4 (four-way), or equal by acceptable manufacturer.

2.5 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: Ivory.
2. Special Receptacles: Black

2.6 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.

2. Material for Finished Spaces: Steel with wrinkled finish, white baked enamel, suitable for field painting, except as otherwise indicated.
 3. Color: Matches wiring device, except as otherwise indicated.
 4. Plate-Securing Screws: Metal with heads colored to match plate finish.
- B. Material for Damp Locations: Heavy-duty die-cast zinc/aluminum construction listed and labeled for use in "wet locations." All components shall have baked-on electrostatic, polyester, power paint finish for superior corrosion resistance. Covers for receptacles shall be equipped with one or more lift cover(s) equipped with stainless steel springs. Covers for toggle switches shall be equipped with actuating levers and shall mount directly over the switch. Covers for receptacles shall comply with 2011 NEC Article 406.9(A). Covers for switches shall comply with 2011 NEC Article 404.4.
1. Duplex Receptacle, 2 Self-Closing Lids – Pass & Seymour Model No. CA8GH or approved equal
 2. GFCI Receptacle, 1 Self-Closing Lid – Pass & Seymour Model No. CA26GH (Horizontal) and Pass & Seymour Model No. CA26GV (Vertical), or approved equal.
 3. Toggle Switch – Pass & Seymour Model No. CA1GL or approved equal.
 4. Toggle switch, lockable cover – Crouse-Hinds Model No. DS185, or approved equal.
- C. Material for Wet Locations: Heavy-duty die-cast zinc/aluminum construction with gasketed, hinged lockable lid, designed to be weatherproof while the device is in use, and listed and labeled for use in "wet locations." All components shall have baked-on electrostatic, polyester, power paint finish for superior corrosion resistance. Covers for receptacles shall be self-closing per UL514C42.3, be equipped with stainless steel springs, and shall have a cam action latch for secure closure. Covers for toggle switches shall be equipped with actuating levers and shall mount directly over the switch. Covers for receptacles shall comply with 2011 NEC Article 406.9(B). Covers for switches shall comply with 2011 NEC Article 404.4.
1. Duplex/GFCI Receptacle - Pass & Seymour Model No. WIUCAST1 or approved equal.
 2. Toggle switch – Pass & Seymour Model No. CA1GL, or approved equal.
 3. Toggle switch, lockable cover – Crouse-Hinds Model No. DS185, or approved equal.
- D. Provide jumbo size plates for outlets installed in masonry walls.

2.7 MULTI-SERVICE FLOOR BOXES (RECTANGULAR):

- A. Complete in-floor multi-service box consisting of floor box housing, flush removable cover, and wiring devices, as specified, all fittings, materials and labor.
- B. Make adjustments in leveling and placement during rough-in to accommodate structural and architectural elements, and other equipment. Coordinate exact locations with Owner prior to concrete pour.

C. Construction:

1. Cast iron for on-grade applications and formed steel at all above grade levels unless otherwise noted on the Drawings.
2. Galvanized steel per ASTM 525 G-60.
3. Concrete-tight for in-floor use.
4. Adjustable legs for leveling and adjustment prior to pour.
5. Knockouts for conduit entry and feed-through use.
6. Two (2) wiring compartments, individually sectionalized.
 - a. One (1) duplex 5-20R power receptacles.
 - b. One (1) Communication mounting plate.
7. UL listed, with separation of power and low voltage.
8. Hinged, completely flush cover with cable ports. Lid to have provisions for carpet insert (Walker #RAKMII option).

- D. Walkerbox Resource RFB Multi-Service steel recessed floor boxes, or equal, by American Electric or Hubell.

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

- A. Install devices and assemblies plumb, level, and secure.
- B. Install wall plates when painting is complete.
- C. 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. Exception: Mount exterior GFCI weatherproof duplex receptacles horizontally with grounding terminals on the left, or as required by the local Authority Having Jurisdiction. Group adjacent switches under single, multi-gang wall plates.
- D. Protect devices and assemblies during painting.
- E. Adjust locations at which floor service outlets are installed to suit arrangement of partitions and furnishings.
- F. Coordinate cord and plug connected equipment for type and ratings required.
- G. All 15 ampere and 20 ampere, 125 volt and 250 volt, non-locking type receptacles installed in damp or wet locations shall be listed weather-resistant type in accordance with 2011 NEC Article 406.9(A) and 406.9(B) and shall be installed within an enclosure that is weather proof when an attachment plug is inserted.
- H. All 15 ampere and 20 ampere, 125 volt, single-phase, non-locking type receptacles installed in the following locations shall have GFCI protection for personnel, in accordance with 2011 NEC Article 210.8(B).
 - 1. Bathrooms/Toilet Rooms
 - 2. Rooftops
 - 3. Outdoors
 - 4. Within six (6) feet (1.8m) of sinks, plumbing fixtures and water piping.
 - 5. Indoor wet locations.
- I. Where multiple receptacles are indicated on the Contract Drawings as GFCI type receptacles, each device must be a GFCI type receptacle. Protecting standard receptacles downstream from one GFCI receptacle is not acceptable.
- J. Switches shall be located as indicated on the drawings, arranged singular or in gangs within 18" of the door jam on the strike side of the door openings. Verify the door swings with the Architectural Drawings prior to rough-in.
- K. Install life safety system switches separate from the normal power switches. Do not include in the multiple gang configuration.
- L. Switch and receptacle combinations shall be as above in a 2-gang box where both are of the same voltage. Provide separate boxes where different voltages are present.
- M. Install receptacles with ground pole in position top unless otherwise required by local authority having jurisdiction.

3.3 IDENTIFICATION

- A. Comply with Division 26 Section “Electrical Identification”.
1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate. Light switches shall be labeled as to lights controlled and with circuit number and panel identification.
 2. Receptacles: 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. 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.

3.4 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.

3.5 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity, continuity, short circuits, and ground continuity. Operate each device at least six times.
- B. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- C. Replace damaged or defective components.

3.6 CLEANING

- A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION

DIVISION 26
SECTION 26 28 13
FUSES
TABLE OF CONTENTS

PART 1 GENERAL

- 1.1 RELATED DOCUMENTS
- 1.2 SUMMARY
- 1.3 PERFORMANCE REQUIREMENTS
- 1.4 SUBMITTALS
- 1.5 QUALITY ASSURANCE
- 1.6 EXTRA MATERIALS

PART 2 PRODUCTS

- 2.1 MANUFACTURERS
- 2.2 CARTRIDGE FUSES

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 FUSE APPLICATIONS
- 3.3 INSTALLATION
- 3.4 IDENTIFICATION

CANNOT BE USED FOR BIDDING

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
 - 3. Coordination charts and tables and related data.
- C. Field test reports indicating and interpreting test results.
- D. Maintenance data for tripping devices to include in the Operation and Maintenance Manual.
- E. Record the equipment nameplate rating and actual fuse rating and location of fuses on the record drawings.

- F. Provide a complete short circuit coordination study report as required to select fuses to protect equipment.

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.
 - 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. Ferraz Corp

4. General Electric Co; Wiring Devices Div.
 5. Gould Shawmut.
 6. 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.

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.
- 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. Provide fuses of type and rating recommended by equipment manufacturer for packaged and/or specialized equipment.
- D. Motor, transformer, feeder, and main service protection - 250 Volts or less:
1. Six hundred (600) ampere and less in interrupter switches, Class RK1, dual elements, time delay, 300 kA interrupting rating.
 2. Four hundred (400) to six hundred (600) ampere in bolted pressure switches, Class J, 300 kA interrupting rating.
- E. Motor, transformer, feeder, and main service protection - 600 volts or less; 600 ampere and less - Class RK-1, dual element, time delay, 300 kA interrupting rating.
- F. Six hundred ampere or less, installed ahead of breaker: Class RK1, time delay.
- G. Six hundred ampere or less, for general power circuits: Class J, time-delay, dual element, 300 kA interrupting rating. Time-delay fuses shall hold 500 percent of rated current for a minimum of 10 seconds and shall be UL listed.

- H. Fuse sizes for motor protection shall be chosen from fuse manufacturers published data and recommendations.
- I. Motor Circuits: All individual motor circuits with full-load ampere ratings (FLA) of 480 amperes or less shall be protected by Dual-Element Time-Delay Fuses. The following guidelines apply for motors protected by properly sized overload relays: 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. 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. The following guidelines apply where fuses are used as the only overload protection for the motor:
 - 1. 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).
 - 2. 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).

3.3 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 are readable without removing fuse.
- C. Provide fuse clips as required.

3.4 IDENTIFICATION

- A. Install typewritten labels on inside door of each fused switch to indicate fuse replacement information.

END OF SECTION

DIVISION 26
SECTION 26 28 16
ENCLOSED SWITCHES
TABLE OF CONTENTS

PART 1 GENERAL

- 1.1 RELATED DOCUMENTS
- 1.2 SUMMARY
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE

PART 2 PRODUCTS

- 2.1 MANUFACTURERS
- 2.2 DISCONNECT SWITCHES

PART 3 EXECUTION

- 3.1 INSTALLATION
- 3.2 FIELD QUALITY CONTROL
- 3.3 ADJUSTING
- 3.4 CLEANING

CANNOT BE USED FOR BIDDING

SECTION 26 28 16 – ENCLOSED SWITCHES

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 individually mounted switches used for the following:
 - 1. Feeder and equipment disconnect switches.
 - 2. Motor disconnect switches.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 26 Section “Wiring Devices” for attachment plugs and receptacles, and snap switches used for disconnect switches.
 - 2. Division 26 Section “Fuses” for fuses in fusible disconnect switches.
- C. Provide method of disconnection at all appliances, motors, equipment, etc., as required to comply with NEC (including Article 422-C, and Article 440-D).

1.3 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 disconnect switches, and accessories specified in this Section.
- C. Product Data for disconnect switches, and accessories specified in this Section. Include the following:
 - 1. Descriptive data and time-current curves.
 - 2. Let-through current curves for circuit breakers with current-limiting characteristics.
- D. Coordination charts and tables and related data.
- E. Wiring diagrams detailing wiring for power and control systems and differentiating between manufacturer-installed and field-installed wiring.
- F. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with

project names and addresses, names and addresses of architects and owners, and other information specified.

- G. Field test reports indicating and interpreting test results.
- H. Maintenance data for tripping devices to include in the operation and maintenance manual specified in Division 01.
- I. Submit a schedule of equipment to indicate ratings of disconnects, fuses, and other electrical characteristics for each item of equipment.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain disconnect switches from one source and by a single manufacturer.
- B. Comply with NFPA 70 for components and installation.
- C. Listing and Labeling: Provide disconnect switches 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. Underwriters Laboratories (UL) listed equipment: UL 98 - Enclosed and Dead Front Switches, UL 50 - Cabinets and Boxes, NEMA 250 - Enclosures for Electrical Equipment.
 - 4. Comply with ANSI and NEMA Standards for materials ratings.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide equipment from one of the following manufacturers; no other manufacturers are acceptable.
 - 1. Disconnect/Safety Switches:
 - a. Square D Company. (Basis of Design)
 - b. Eaton Corp.; Cutler-Hammer.
 - c. Siemens Energy & Automation, Inc.

2.2 DISCONNECT SWITCHES

- A. Enclosed, Nonfusible Switch: Heavy duty, NEMA KS 1, Type HD, with lockable handle in the *OFF* position. Switch shall be provided with an override screw to permit opening front cover with switch in *ON* position. Minimum fault current rating shall be 200,000 symmetrical rms amperes.
- B. Enclosed, Fusible Switch, 800 A and Smaller: Heavy duty, NEMA KS 1, Type HD, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable in the *OFF* position, with 2 padlocks, and interlocked with cover in *CLOSED* position. Switch shall be provided with an override screw to permit opening front cover with switch in *ON* position. Minimum fault current rating shall be 200,000 symmetrical rms amperes.
- C. Characteristics: Size, number of poles and ratings as indicated and to match load being served.
- D. Enclosure: NEMA KS 1, Type 1, with gray baked enamel finish, unless otherwise specified or required to meet environmental conditions of installed location. Enclosure shall be rated for 200,000 rms symmetrical amperes short circuit current.
 - 1. Outdoor Locations: Type 3R, with top-hinged, attached with removable screws.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches in locations as indicated, according to manufacturer's written instructions.
- B. Install disconnect switches level and plumb. Provide mounting brackets, wall bracing, and accessories as required.
- C. Install wiring between disconnect switches, control, and indication devices.
- D. Connect disconnect switches and components to wiring system and to ground as indicated and instructed by manufacturer.
 - 1. Tighten electrical connectors and terminals 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.
- E. Identify each disconnect switch according to requirements specified in Division 26 Section "Electrical Identification". All switches shall be provided with laminated plastic labels which clearly identify the equipment served.
 - 1. Each disconnect means shall be legibly marked as required by Code (including all disconnect units for motors, appliances, feeders, and branch(es)).
- F. Provide fuses for all fusible safety switches as indicated and required by the load being served. Coordinate fusing of disconnects with mechanical equipment electrical characteristics.

- G. Provide disconnect switches for all equipment as indicated and as required by the NEC. Where disconnect switches are specified and furnished with mechanical equipment, install one only. Coordinate devices furnished for mechanical equipment with Division 23 Drawings and Specifications.
- H. Weatherproof disconnect switches shall be provided for all locations exposed to the elements whether called for or not.
- I. Disconnect switches provided shall be suitable for:
 - 1. Circuit application voltage.
 - 2. Circuit application ampacity x 125 percent.
 - 3. One pole, two pole, three pole, solid neutral, ground connection, all as required by item served or as shown on the drawings.
- J. Install circuit and motor disconnect switches as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's *Standard of Installation*, and in accordance with recognized industry practices.

3.2 FIELD QUALITY CONTROL

- A. Testing: After installing disconnect switches and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for disconnect switches and Section 7.6 for molded-case circuit breakers.
 - 2. Certify compliance with test parameters.
- B. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.3 ADJUSTING

- A. Set field-adjustable disconnect switches trip ranges as indicated.

3.4 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

END OF SECTION

DIVISION 26
SECTION 26 51 00
INTERIOR LIGHTING
TABLE OF CONTENTS

PART 1 GENERAL

- 1.1 RELATED DOCUMENTS
- 1.2 SUMMARY
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
- 1.5 COORDINATION
- 1.6 WARRANTY
- 1.7 EXTRA MATERIALS

PART 2 PRODUCTS

- 2.1 MANUFACTURERS
- 2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL
- 2.3 LAMP HOLDERS
- 2.4 FINISHES
- 2.5 FLUORESCENT LAMP BALLASTS
- 2.6 EMERGENCY BATTERY PACKS
- 2.7 EXIT SIGNS
- 2.8 LAMPS
- 2.9 FIXTURE SUPPORT COMPONENTS
- 2.10 FIXTURES

PART 3 EXECUTION

- 3.1 INSTALLATION
- 3.2 GENERAL INSTALLATION OF FIXTURES
- 3.3 CONNECTIONS
- 3.4 FIELD QUALITY CONTROL
- 3.5 CLEANING AND ADJUSTING

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes interior lighting fixtures, lamps, ballasts, emergency lighting units, and accessories.
- B. Provide a lighting fixture for each fixture shown on the Drawings as described in this Specification, of the design and quality indicated herein. Provide fixtures complete, including lamps of the wattage and type indicated.
- C. All materials, accessories, and any other equipment necessary for the complete and proper installation of all lighting fixtures included in this contract shall be furnished by the Contractor.
- D. Conformance: Fixtures shall be manufactured in strict accordance with the Contract Drawings and Specifications.
- E. Specifications and scale Drawings are intended to convey the salient features, function and character of the fixtures only, and do not undertake to illustrate or set forth every item or detail necessary for the work.
- F. Minor details, not usually indicated on the Drawings nor specified, but that are necessary for the proper execution and completion of the fixtures, shall be included, the same as if they were herein specified or indicated on the Drawings.
- G. Omissions: The Owner shall not be held responsible for the omission or absence of any detail, construction feature, etc., which may be required in the production of the fixtures. The responsibility of accurately fabricating the fixtures to the fulfillment of this Specification rests with the Contractor.

1.3 SUBMITTALS

- A. Product Data: Submit fixture shop drawings in booklet form with separate sheet for each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:
 - 1. Dimensions of fixtures.
 - 2. Certified results of independent laboratory test for fixtures and lamps for electrical ratings and photometric data. Test data shall include manufacturer and model number for fixture being submitted.
 - 3. Emergency lighting unit battery and charger.

4. Fluorescent ballasts.
 5. Types of lamps.
- B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, method of field assembly, components, features, and accessories.
1. Wiring Diagrams: Detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.
- C. Product Certificates: Signed by manufacturers of lighting fixtures certifying that products comply with requirements.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- E. Record Documents: Accurately record actual location of each luminaire with the associated switching/control arrangement.
- F. Maintenance Data: For lighting fixtures to include in maintenance manuals specified in Division 01. Include technical data sheets and parts ordering information. Include testing and maintenance requirements and instructions for emergency lighting equipment.
- G. Lighting Calculations: Submit point-by-point lighting calculations for fixture types noted in this Specification. All calculations shall strictly conform to IES Standards.

1.4 QUALITY ASSURANCE

- A. Fixtures, Emergency Lighting Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction. Provide only UL listed and labeled fixtures with UL listed wiring. Wiring shall be suitable for the fixture temperature listing.
- B. Comply with NFPA 70.
- C. FM Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM.
- D. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.
- E. Mockups: Provide lighting fixtures for room or module mockups where required by the Architect. Install fixtures for mockups with power and control connections.
1. Obtain Architect's approval of fixtures for mockups before starting installations.
 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

3. Remove mockups when directed. Fixtures may be reinstalled in the Work with approval of Architect.
 4. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. UL Listing: All fixtures shall be manufactured in strict accordance with the appropriate and current requirements of the Underwriters' Laboratories, Inc. (Standards for Safety), and others as they may be applicable. A UL listing shall be provided for each fixture type and the appropriate label or labels shall be affixed to each fixture in a position concealing it from normal view.
- G. Installer: All Installers shall have not less than five (5) years' experience in the installation of lighting fixtures of the type and quality shown.
- H. Materials, equipment and appurtenances, as well as workmanship provided under this Section, shall conform to the highest commercial standard as specified and as indicated on the drawings.
- I. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Articles 220, 410, and 510 as applicable to installation, and construction of interior building lighting fixtures.
- J. NEMA Compliance: Comply with applicable requirements of NEMA Standards Publication Numbers LE1 and LE2 pertaining to lighting equipment and LE4 pertaining to recessed luminaires.
- K. IES Compliance: Comply with IES RP-1 pertaining to office lighting practices and RP-15, regarding selection of illuminance values for interior office building.
- L. UL Compliance: Comply with UL Standards, including UL 486A and B, pertaining to interior lighting fixtures. Provide interior lighting fixtures and components which are UL-listed and labeled.
- M. CBM Labels: Provide fluorescent lamp ballasts which comply with Certified Ballasts Manufacturer's Association Standards and carries the CBM label.
- N. NECA/IESNA Compliance: Comply with NECA/IESNA 500 – 1998 Standard, Installing Indoor Commercial Lighting Systems (ANSI).

1.5 COORDINATION

- A. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction. Provide plaster frames, hangers, trim rings, and fittings, as required for each type of ceiling construction.
- B. The Contractor shall coordinate switch and lighting control devices with door swings and other architectural features.
- C. The Contractor shall be responsible for providing the required quantity of ballasts to provide the control and operations of the lighting fixtures as indicated by the lighting

controls on the Drawings. For example, where two switches are indicated to serve fixtures, then two ballasts per fixture shall be provided.

1.6 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty for Batteries: Written warranty, executed by manufacturer agreeing to replace rechargeable batteries that fail in materials or workmanship within specified warranty period.
 - 1. Special Warranty Period for Batteries: Manufacturer's standard, but not less than 5 years from date of Substantial Completion.
- C. Special Warranties for Fluorescent Ballasts: Written warranty, executed by manufacturer agreeing to replace fluorescent ballasts that fail in materials or workmanship within specified warranty period.
 - 1. Special Warranty Period for Electronic Ballasts: Five years from date of manufacture, but not less than four years from date of Substantial Completion.
 - 2. Special Warranty Period for Electromagnetic Ballasts: Manufacturers' standard warranty, but not less than two years from date of manufacture.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Plastic Diffusers and Lenses: 1 for every 50 of each type and rating installed. Furnish at least one of each type.
 - 3. Ballasts: 1 for every 50 of each type and rating installed. Furnish at least one of each type.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, the products indicated in this Specification.
- B. Data listed and model number shown, in this Specification for each fixture type indicate minimum requirements and no exceptions will be made.

2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs, sharp corners, and edges.
- B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.
- D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.
 - 1. Plastic for lenses and diffusers shall be formed of colorless 100% virgin acrylic as manufactured by Rhom & Haas, Dupont, or as acceptable. The quality of the raw material must equal or exceed IES, SPI and NEMA Specifications by at least 100%--which, as a minimum standard, shall not exceed a yellowness factor of 3 after 2,000 hours of exposure in the Fade-meter or as tested by an independent test laboratory. Acrylic plastic lenses and diffusers shall be properly cast, molded or extruded as specified, and shall remain free of any dimensional instability, discoloration, embrittlement, or loss of light transmittance for at least 15 years.
 - 2. Lens Thickness: 0.125 inch (3 mm) minimum, unless greater thickness is indicated.
 - 3. Where optical lenses are used, they shall be free from spherical and chromatic aberrations and other imperfections which may hinder the functional performance of the lenses.
 - 4. Mechanical: All lenses, louvers, or other light diffusing elements shall be removable, but positively held so that hinging or other normal motion will not cause them to drop out.
 - 5. Cleaning: All lenses shall be turned over to the Owner clean and free of dust.

2.3 LAMP HOLDERS

- A. Fluorescent: Body - white urea plastic. Contacts: silver-plated phosphor bronze.

2.4 FINISHES

- A. Painted Surfaces: Synthetic enamel, with acrylic, alkyd, epoxy, polyester, or polyurethane base, light stabilized, baked on at 350 degree Fahrenheit minimum, catalytically or photo-chemically polymerized after application.
- B. Ceiling opening frames shall either be manufactured of non-ferrous metal, or be suitably rust-proofed after fabrication.
- C. Selection: Unless otherwise noted, finishes shall be as selected by the Architect.
- D. Undercoat: Except for stainless steel, give ferrous metal surfaces a five-stage phosphate treatment or other acceptable base bonding treatment before final painting and after fabrication.
- E. Unpainted non-reflecting surfaces shall be satin finished and coated with a stoved clear lacquer to preserve the surface. Where aluminum surfaces are treated with an anodic process, the clear lacquer coating may be omitted.
- F. Unpainted Aluminum Surfaces: Finish interior aluminum trims with an anodized coating of not less than 7 mg per square inch, of a color and surface finish as selected by the Architect. Finish exterior aluminum trims with an anodized coating of not less than 35 mg per square inch or a color and surface finish as selected by the Architect.
- G. Porcelain Enamel Surfaces: Apply porcelain finishes smoothly. Finish shall be not less than 7.5 mils thick of non-yellowing, white, vitreous porcelain enamel with a reflectance of not less than 85%.
- H. Fixtures: Manufacturer's standard, unless otherwise indicated.
 - 1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
 - 2. Metallic Finish: Corrosion resistant.
- I. White finishes: Minimum of 85 percent reflectance.

2.5 FLUORESCENT LAMP BALLASTS

- A. Fluorescent Lamp Ballast Manufacturers: Provide quality ballasts by the Manufacturers listed below. Off-brand/generic ballasts shall NOT be acceptable.
 - 1. Advance.
 - 2. Lutron.
 - 3. General Electric.
 - 4. Valmont.

5. Universal
- B. General Requirements: Unless otherwise indicated, features include the following:
1. Designed for type and quantity of lamps indicated at full light output.
 2. Conform to UL 935 *Fluorescent - Lamp Ballasts*.
 3. Total Harmonic Distortion Rating: Less than 10 percent.
 4. Sound Rating: A.
 5. Conform to ANSI C82.1 Specifications for Fluorescent Lamp Ballast.
 6. Warranty: Minimum 2 years of warranty after the date of acceptance for all types of ballasts.
- C. Electronic Ballasts for Linear Lamps: Unless otherwise indicated, features include the following, besides those in "General Requirements" Paragraph above:
1. Certified Ballast Manufacturer Certification: Indicated by label.
 2. Lamp Starting Method: Programmed start.
 3. Nominal Ballast Factor: 87 percent, minimum, unless otherwise indicated.
 4. Power Factor: 90 percent, minimum.
 5. Encapsulation: Without voids in potting compound.
 6. Third Harmonic Content of Ballast Current: Less than 10 percent.
 7. Conform to IEEE C62.41, Category A.
 8. Conform to FCC Regulations, Part 15, Subpart J.
 9. Lamp Current Crest Factor shall be less than 1.7.
 10. Parallel Lamp Circuits: Multiple lamp ballasts connected to maintain full light output on surviving lamps if one or more lamps fail.
- D. Ballasts for Low-Temperature Environments: As follows:
1. Temperatures 0°F (-17 °C) and Above: Electronic or electromagnetic type rated for 0°F (-17°C) starting temperature.
 2. Temperatures -20°F (-29°C) and Above: Electromagnetic type designed for use with high-output lamps.
- E. Ballasts for outdoor environments shall be of the low temperature type (0°F minimum).

- F. Ballasts for special applications, as indicated, to minimize EMI/RFI shall comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

2.6 EMERGENCY BATTERY PACKS:

- A. Unless otherwise indicated, features include the following:

1. Conform to UL 924 “Emergency Lighting and Power Equipment”
2. Conform to NFPA 101 and International Building Code (IBC) requirements.
3. Initial Light Output: Provide as indicated.
4. Illumination time: 90 minutes, minimum.
5. Battery: Long life, high temperature, maintenance-free Nickel-Cadmium battery with test switch.
6. Self-Testing Diagnostics: Provide as indicated.
7. Cold Weather Operation: Provide as indicated.
8. Warranty: Minimum 5 year full product warranty.
9. Manufacturers: Provide specification grade emergency battery ballasts by the Manufacturers listed below. Off-brand/generic ballasts shall NOT be acceptable.
 - a. Power Sentry
 - b. Bodine
 - c. Iota

2.7 EXIT SIGNS

- A. General Requirements: Comply with UL 924, “Emergency Lighting and Power Equipment”, and the following:

1. Sign Colors and Lettering Size: Comply with authorities having jurisdiction.

- B. Internally Lighted Signs: As follows:

1. Lamps for AC Operation: Light-emitting diodes (LED), 25 + years rated lamp life.

2.8 LAMPS

- A. Fluorescent Color Temperature and Minimum Color-Rendering Index: 3500K and 85 CRI, unless otherwise indicated.

1. Fluorescent Lamps - Outdoor: High output, cool white, lengths as required.
- B. Noncompact Fluorescent Lamp Life: Rated average is 20,000 hours at 3 hours per start when used on rapid-start circuits.
- C. Lamps installed in outdoor environments shall be rated for low temperature applications (0°F, minimum).
- D. Lamps shall conform to ANSI Standards C78 series and shall be as manufactured by General Electric, Philips, or Sylvania.

2.9 FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section “Common Work Results for Electrical” and Division 26 Section “Hangers and Supports”, for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (12-mm) steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch (12-mm) steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.
- D. Rod Hangers: 3/16-inch- (5-mm-) minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.
- F. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.
- G. Recessed fixtures shall be removable from below to allow access to outlet/junction boxes in ceiling spaces.
- H. Each fixture shall be supplied with necessary straps, supports, or hangers, or other miscellaneous materials and devices to install them in a satisfactory manner to conform to architectural treatment and finishes in area in which they are to be installed. Consult all Mechanical, Architectural and Structural Plans and related Contract Documents to be familiar with all necessary details for proper fixture placement. Failure to do so will not relieve the Contractor of responsibility of furnishing all necessary material, complete to perform function intended for indicated lighting system.

2.10 FIXTURES

- A. Fixture: Type A
 1. Voltage: 120 VAC
 2. Mounting: Recessed, lay-in ceiling.

3. Nominal Dimensions: 2' x 4' x 13-11/16"
4. Lamps: (3) 28 Watt T8 ES Fluorescent
5. Ballasts Type and Features: Single electronic less than 10% total harmonic distortion. Ballast disconnect means per NEC 2005 Article 410.73(G) shall be factory or contractor installed on each ballast.
6. Lens: #12 pattern acrylic, reverse apex, .125" minimum thickness.
7. External Finish: White painted parts finish with high-gloss baked enamel with five-stage iron-phosphate pretreatment.
8. Trim and Hardware: White powder painted door latches and flush steel door frame. Die-formed heavy-gauge T hinges.
9. Manufacturers:
 - a. Lithonia 2SP8 G Series
 - b. Columbia ST824 Series
 - c. Metalux 2GC8 Series
 - d. Daybrite 2DP Series
 - e. H.E.Williams 50 Series

B. Fixture: Type B

1. Voltage: 120 VAC
2. Mounting: Recessed, lay-in ceiling.
3. Nominal Dimensions: 2' x 4' x 13-11/16"
4. Lamps: (2) 28 T8 ES Watt Fluorescent
5. Ballasts Type and Features: Single electronic less than 10% total harmonic distortion. Ballast disconnect means per NEC 2005 Article 410.73(G) shall be factory or contractor installed on each ballast.
6. Lens: #12 pattern acrylic, reverse apex, .125" minimum thickness.
7. External Finish: White painted parts finish with high-gloss baked enamel with five-stage iron-phosphate pretreatment.
8. Trim and Hardware: White powder painted door latches and flush steel door frame. Die-formed heavy-gauge T hinges.
9. Manufacturers:
 - a. Lithonia 2SP8 G Series
 - b. Columbia ST824 Series

- c. Metalux 2GC8 Series
- d. Daybrite 2DP Series
- e. H.E.Williams 50 Series

C. Fixture: Type C

1. Voltage: 120 VAC
2. Mounting: Wall surface.
3. Nominal Dimensions: 48" x 4-1/2" x 5"
4. Lamps: (2) 28 Watt T8 ES Fluorescent
5. Ballasts Type and Features: Single electronic less than 10% total harmonic distortion. Ballast disconnect means per NEC 2005 Article 410.73(G) shall be factory or contractor installed on each ballast.
6. Shielding: Matte white opal acrylic diffuser.
7. Construction: Baked white polyester housing formed from die-formed steel with full end caps.
8. Manufacturers:
 - a. Lithonia WC series
 - b. Columbia W Series
 - c. Nulite DW Series
 - d. Metalux BC Series

D. Fixture: Type D

1. Voltage: 120VAC
2. Mounting: Surface wall
3. Nominal Dimensions: 9-1/2" x 10-3/4" x 2-1/4"
4. Driver: (2) 10 watt high output long life multi-chip LED, constant current, class 2.
5. Construction: Die-cast aluminum housing, lens frame and mounting plate.
6. Other Features: UL listed wet location, 4,000k color temperature, minimum starting temperature is -30°C, full cutoff. Finish shall be bronze polyester powder coat.
7. Manufacturers:
 - a. RAB Lighting WPLED 20N

E. Fixture: Type E

1. Voltage: 120VAC
2. Mounting: Surface mounted, wall.
3. Nominal Dimensions: 12-1/2" x 5" x 3-3/4"
4. Lamps: (2) 5.4 Watt Krypton lamps
5. Battery: 6 volt, 12 watt sealed lead-cadium maintenance free battery.
6. Electronics: Low-voltage disconnect, constant-current series charger, current-limiting charger and AC/LV reset (line latch) shall allow battery connection before AC power is applied and prevents battery damage from deep discharge. Brownout protection shall be automatically switched to emergency mode when supply voltage drops below 80% of nominal.
7. Construction: Low-profile engineering grade thermoplastic housing shall be impact-resistant, scratch-resistant and corrosion proof. UL94V-0 flame rating. UV-stable resin shall resist discoloration from natural and man-made light sources.
8. External Finish: White.
9. Other Features: Self-diagnostics.
10. Manufacturers:
 - a. Lithonia ELM2 series
 - b. Dual Lite LZ Series
 - c. Sure-Lites AP25Q Series

F. Fixture: Type X

1. Voltage: 120VAC
2. Mounting: Universal.
3. Nominal Dimensions: 12 1/4" x 10" x 2 1/4"
4. Lamps: Light-Emitting Diodes (LEDs) and (2) 5.4 Watt Krypton lamps
5. Battery: Sealed, maintenance free high output lead-cadium.
6. Shielding: White stencil face with red letter color.
7. Construction: Engineering grade thermoplastic housing shall be impact-resistant, scratch resistant and corrosion-proof. UL94-O flame rating. UV-stable resin shall resist discoloration from natural and man-made light sources.

8. Electronics: Two-rate regulated charger. AC/LVD reset shall allow battery connection before AC power is applied.
 9. Manufacturers:
 - a. Lithonia LHQM Series
 - b. Dual-Lite HCX Series
 - c. Sure-Lite APCH7 Series
- G. Fixture: Type XR
1. Voltage: 6VDC
 2. Mounting: Surface-mounted, wall/ceiling.
 3. Nominal Dimensions: 3-1/2" diameter x 5" long.
 4. Lamps: (1) 6 Watt PAR 36 lamp.
 5. Construction: Fiberglass – reinforced Lexan.
 6. External Finish: Black polyester powder coat finish.
 7. Other Features: UL Wet Location Listed. Mounts to 3-1/2" octagonal or single gang outlet boxes.
 8. Manufacturers:
 - a. Lithonia ELA NX series
 - b. Dual Lite SRH Series
 - c. Sure-Lites Weatherproof Series

PART 3 EXECUTION

3.1 INSTALLATION

- A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.
- B. Support for Fixtures independent of ceiling systems, ducts, and piping.
 1. Install a minimum of four support system rods or wires for each fixture from structure above. Locate not more than 6 inches (150 mm) from fixture corners.
 2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner.
 3. Fixtures of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently

with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.

- C. Suspended Fixture Support: As follows:
1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
 4. Continuous Rows: Suspend from cable installed according to fixture manufacturer's written instructions and details on Drawings. Provide alignment fittings as required for uniform, level installation of continuous rows of suspended fixtures.
- D. Fixture installations with fixtures supported only by insecure boxes will be rejected. It shall be the Contractor's responsibility to support all lighting fixtures adequately, providing extra steel work for the support of fixtures if required. Any components necessary for mounting fixtures shall be provided by the Contractor. No plastic, composition or wood type anchors shall be used.
- E. Setting and Securing: Set units plumb, square, and level with ceiling and walls, and secure according to manufacturer's printed instructions and approved shop drawings.
- F. Support for Recessed and Semi-Recessed Fixtures: Installed units may not be supported from suspended ceiling support system. Install ceiling system support rods or wires at a minimum of four rods or wires per fixture located not more than 6 inches from the fixture corners.
1. Fixtures Smaller Than Ceiling Grid: Install a minimum of four rods or wires for each fixture and locate at corner of the ceiling grid where the fixture is located. Do not support fixtures by ceiling acoustical panels.
 2. Fixtures of Sizes Less than Ceiling Grid: Center in the acoustical panel. Support fixtures independently with at least two 3/4-inch metal channels spanning and secured to the ceiling tees.
 3. Recessed fixtures shall be provided with the proper plaster frame or suitable adapter to receive the finished ceiling construction.
 4. Recessed lighting fixtures shall be suitable for the ceiling or wall material and construction in which they will be installed.
 5. Recessed mounted lighting fixtures shall be connected to a junction box with flexible conduit. Final connection to light fixture shall be with heat-resistant wire of the following type:
 - a. Recessed fluorescent 120 or 277 volt, No. 12 RHH or THHN.

- G. Each lighting fixture shall be rigidly supported from the building construction and shall include suspension hangers, devices, and extra steel work for fixture support where required.
1. Support all lighting fixtures adequately. Special supports shall be installed as required.
 2. Luminaires shall be furnished with all necessary stems, plaster frames, hangers, for the safe support of the fixture. All supports for fixtures shall be adequate to support weight of the fixtures. All visible hanging devices and appurtenances shall have the same finish as the fixture unless specifically indicated otherwise.
- H. Coordinate with the work of other trades to determine modifications required to make fixtures suitable for ceilings as installed and verify the types of ceiling construction prior to fixture fabrication. Determine that the suspension method and the flange arrangement for the fixtures coordinates with the ceiling type and its suspended system. Fixtures which are shipped to the project and do not fit, or which otherwise do not match the ceiling system, shall be returned for correction at no additional cost.
- I. Lamping: Lamp units according to manufacturer's instructions.
- J. Installation shall include receiving, checking, storage in a safe and approved area until they are required for installation, unpacking, assembly of separate fixture components where required, and complete wiring and connection including the provision of associated wiring and connection devices such as fittings, hangers, aligners, box covers, and similar hardware which may be required for certain fixtures, but are not detailed or scheduled with the fixtures.
- K. Plaster frames or mounting frames shall be provided for all fixtures which require them and shall be suitable for the ceiling construction in which they will be installed.
- L. Trim rings shall be painted to match the finish of the adjacent ceiling surface.
- M. All lighting fixtures, when installed, shall be set free of light leaks, warps, dents, or other irregularities.
- N. Pendant-type fixtures shall be hung at heights as required, and as shown on the Drawings.
- O. In certain areas shown on the Drawings, the locations of fixtures are approximate only and the exact locations and pendant lengths will be determined for each individual fixture by the Owner's Representative.
- P. Install all lamps required, including replacements for burned out lamps, until final acceptance of the completed work. No lighting fixture or sign will be installed without lamps.
- Q. If permanent lighting fixtures are to be used in lieu of temporary lighting facilities during the construction period, this shall be done only as permitted by the Owner's Representative, who may require that new lamps be installed and fixtures cleaned at the time of turnover to the Owner.

- R. Lighting fixtures for general illumination, emergency lighting, and exterior lighting, shall be complete with all required accessories and attachments.
- S. Fixtures shall bear UL label and shall be wired and installed in full compliance with applicable codes.
- T. The omission of a type or quantity in this Specification shall not relieve the Contractor of the responsibility of installing all required fixtures, of proper type, as shown on the Drawings.
- U. Fixtures shall be recessed, surface, or pendant type, as specified and shall include sockets, diffusers, ceiling canopies and stems, hickey, and all other necessary accessories.
- V. Where suspended ceilings with steel channels occur, outlets and fixtures shall be supported on members resting on the channel framework. In no case shall fixtures be supported from plasterboard, plaster, or acoustic material.

3.2 GENERAL INSTALLATION OF FIXTURES

- A. Install interior lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's *Standard of Installation*, NEMA Standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.
- B. All recessed fixtures mounted in dry wall or plaster ceilings shall be complete with a suitable plaster frame or trim ring. All fixtures shall be mounted on or in ceilings in accordance with published recommendations of the manufacturers using bar or swing-way hangers, etc. These items shall be furnished as part of the fixture whether called for by catalog number or not.
- C. All fixtures shall be installed in strict accordance with NEC Article 410 and shall properly and suitably support the weight of any fixture installed. All fixtures shall be supported independently of ceiling suspension system being attached to building structure.
- D. Fixtures indicated to be pendant-mounted shall be suspended with single stem hanger, maximum 40" on center. Hangers shall have suitable means for vertical adjustment and built-in positive horizontal leveling provisions.
- E. Regardless of catalog number in lighting fixture schedule, every fixture shall be of the type for the ceiling construction in or on which it is to be installed. It shall be the Electrical Contractor's responsibility to coordinate this with the Ceiling Contractor.
- F. All fluorescent lighting fixtures having exposed (bare) lamps shall be provided with safety sleeves (one per each lamp). Sleeves shall be "Arm-a-lite", as manufactured by Thermoplastic Process, Inc., or approved equal. Fixtures with wire guards and/or shielding (louvers, baffles, lenses) beneath the lamps shall not be considered as exposed.

- G. Install flush-mounted fixtures properly to eliminate light leakage between fixture frame and finished surface.
- H. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B, and the National Electrical Code.

3.3 CONNECTIONS

- A. Ground equipment. 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.

3.4 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Advance Notice: Give dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests: As follows:
 - 1. Verify normal operation of each fixture after installation.
 - 2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.
 - 3. Verify normal transfer to battery source and retransfer to normal.
 - 4. Report results in writing.
- E. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.
- F. Corrosive Fixtures: Replace during warranty period.

3.5 CLEANING AND ADJUSTING

- A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.
- B. Adjust aimable fixtures to provide required light intensities.
- C. Touch up luminaire finish at completion of work.
- D. Replace all burned-out / non-operating lamps at the time of substantial completion.
- E. Replace all fluorescent lamps that fail within three (3) months of Substantial Completion.

- F. Replacement Lamps: At the time of substantial completion and prior to field tests, replace lamps in interior lighting fixtures which are observed to be noticeably dimmed after Contractor's use and testing. Furnish stock or replacement lamps as specified in this Section, Paragraph "Extra Materials". Deliver replacement stock as directed. Refer to Division 01 Sections for the replacement/restoration of lamps in interior lighting fixtures, and where used, the temporary lighting prior to time of substantial completion.

END OF SECTION

CANNOT BE USED FOR BIDDING

DIVISION 26
SECTION 26 56 00
EXTERIOR LIGHTING
TABLE OF CONTENTS

PART 1 GENERAL

- 1.1 RELATED DOCUMENTS
- 1.2 SUMMARY
- 1.3 DEFINITIONS
- 1.4 SUBMITTALS
- 1.5 QUALITY ASSURANCE
- 1.6 DELIVERY, STORAGE, AND HANDLING OF POLES
- 1.7 WARRANTY
- 1.8 EXTRA MATERIALS
- 1.9 COORDINATION

PART 2 PRODUCTS

- 2.1 MANUFACTURERS
- 2.2 LUMINAIRES
- 2.3 LUMINAIRE SUPPORT COMPONENTS
- 2.4 FIXTURES
- 2.5 FINISHES
- 2.6 SPLICES, TAPS

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 FIELD COORDINATION
- 3.3 DEMOLITION
- 3.4 INSTALLATION
- 3.5 UNDERGROUND DUCT LINES
- 3.6 GROUNDING
- 3.7 CONNECTIONS
- 3.8 FIELD QUALITY CONTROL
- 3.9 CLEANING AND ADJUSTING
- 3.10 DEMONSTRATION
- 3.11 LAMP REPLACEMENT AND PROVISION OF SPARE LAMPS

SECTION 26 56 00 - EXTERIOR LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes exterior lighting units with luminaires, lamps, drivers, poles/support structures, and accessories.
- B. Related Sections include the following:
 - 1. Division 26 Section “Interior Lighting” for lighting fixtures installed on the exterior walls of the building.

1.3 DEFINITIONS

- A. Lighting Unit: A luminaire or an assembly of luminaires complete with a common support, including pole, post, or other structure, and mounting and support accessories.
- B. Luminaire (Light Fixture): A complete lighting device consisting of lamp(s) and driver(s), when applicable, together with parts designed to distribute light, to position and protect lamps, and to connect lamps to power supply.

1.4 SUBMITTALS

- A. Product Data: Provide dimensioned and detailed drawings in booklet form with separate sheets for each type of lighting unit indicated, arranged in order of lighting unit type and designation. Include data on features, accessories, finishes, and the following:
 - 1. Materials and dimensions of luminaires and poles.
 - 2. Certified results of independent laboratory tests for fixtures and lamps for electrical ratings and photometric data. Include manufacturer and model number of fixture being submitted.
 - 3. Lamp ANSI designation, initial and mean lumen output, average-rated hours of lamp life and lamp mortality curve, and color temperature and color rendering index.
 - 4. Driver ANSI designation; electrical characteristics, including voltages, lamp and line operating and starting amperes, watts and watt losses, percent of allowable line voltage variation range and lamp crest factor; minimum lamp starting temperature; and normal and maximum ballast operating temperature.
 - 5. Driver CBM approval and UL listing, volts, lamp and input amperes, input watts, and minimum lamp starting temperature.

6. Poles and standards dimensions, details of hand holes and wire entries, mast or bracket arms and connection to poles, wind load and deflection, and finishes.
- B. Shop Drawings: Anchor-bolt templates keyed to specific poles and certified by manufacturer.
 - C. Product Certificates: Signed by manufacturers of lighting units certifying that products comply with requirements, including Driver Test Report, indicating conformance with maximum 90 degrees C case temperature.
 - D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
 - E. Record Documents: Accurately record actual location of each luminaire with the switching arrangements shown.
 - F. Submit pole load calculations, including EPA wind load calculations, for all poles. Calculations shall include all pole-mounted devices including luminaires. Refer to this Section, Paragraph “Fixtures” for additional information. Wind resistance calculations shall be certified by a Registered Professional Engineer.
 - G. Submit point by point lighting calculations for layout shown on the Contract Drawings if utilizing lighting fixture(s) other than first-named fixtures in this Specification (Basis of Design). All calculations shall strictly comply with IES Standards. Indicate foot candle readings minimum 5'-0-inches on center along the horizontal plane.
 - H. Submit fixture schedule as follows:
 1. Must be approved before any fixture is ordered.
 2. Include, in detail, the following items:
 - a. Type
 - b. Wattage
 - c. Voltage
 - d. Efficiency
 - e. Suspension
 - f. Glassware
 - g. Finished diameters
 - h. Mounting Heights
 - i. Lamps
 - j. Locations
 - k. Remarks
 - l. Appurtenances
 - I. Maintenance Data: Submit maintenance data and parts list for each exterior lighting fixture and accessory; including trouble-shooting maintenance guide. Include that data, product data, and shop drawings in a maintenance manual; in accordance with requirements of Division 01.

1.5 QUALITY ASSURANCE

- A. Luminaires and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for their indicated use, location, and installation conditions by a testing agency acceptable to authorities having jurisdiction.
- B. ANSI/ASTM Compliance: Comply with applicable requirements of ANSI C2, *National Electrical Safety Code*.
- C. FM Compliance: Units for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM.
- D. Comply with recommended practices of Illuminating Engineering Society (IES).
- E. All products shall comply with UL and shall be UL listed.
- F. Manufacturer's Qualifications: Firms regularly engaged in manufacture of exterior building lighting fixtures of types and ratings required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- G. Installer's Qualifications: Firm with at least three (3) years of successful installation experience on projects with exterior lighting fixture work similar to that required for the project.
- H. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Articles 25, 250, 410, and 501 as applicable to installation, and construction of lighting fixtures encompassed by this section.
- I. NEMA Compliance: Comply with applicable requirements of NEMA Standards Publication No. LE 2 pertaining to lighting equipment.
- J. IES Compliance: Comply with IES RP-8, 19, 20, and PB-15 pertaining to exterior, parking, and roadway lighting practices and fixtures.
- K. UL Compliance: Comply with requirements of UL Standards, including Standards 486A and B, pertaining to exterior lighting fixtures. Provide exterior lighting fixture and components which are UL listed and labeled.
- L. NFPA Compliance: Comply with applicable requirements of NFPA 78, *Lightning Protection Code*, pertaining to installation of exterior lighting fixtures.
- M. Code compliance is mandatory. Nothing in the Drawings and Specifications implies acceptance of work not conforming to these codes. Where work is shown to exceed minimum code requirements, comply with the Drawings and Specifications.
- N. Codes and Standards: Provide luminaires, poles, standards and appurtenances conforming to the following:

1. Conform to applicable sections of American Association of State Highway and Transportation Officials (AASHTO):
 - a. LTS-1: Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.
2. American National Standards Institute (ANSI):
 - a. C2: National Electrical Safety Code.
3. Conform to applicable sections of American Society for Testing and Materials (ASTM).
 - a. B429: Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
4. National Electrical Manufacturers Association (NEMA):
 - a. FA1: Outdoor Floodlighting Equipment.
 - b. OD3: Physical and Electrical Interchangeability of Photo Control Devices and Mating Receptacles.
 - c. SH5: Tubular Steel, Aluminum, and Prestressed Concrete Poles.
5. Conform to applicable sections of National Fire Protection Association (NFPA) 70, *National Electrical Code*.
6. Underwriters Laboratories, Inc. (UL):
 - a. 57: Electric Lighting Fixture
7. Conform to all local requirements for maximum pole heights and pole setback distances from property lines.

1.6 DELIVERY, STORAGE, AND HANDLING OF POLES

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant treated skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Retain factory-applied pole wrappings on poles until just before pole installation. Handle poles with web fabric straps.
- D. Deliver exterior lighting fixtures in factory-fabricated containers or wrappings, which properly protect fixtures from construction debris and physical damage.
- E. Store exterior lighting fixtures in original wrappings in a clean dry space. Protect from weather, dirt, fumes, water, construction debris, and damage.

- F. Handle exterior lighting fixtures carefully to prevent damage, breaking, and scoring. Do not install damaged fixtures or components; remove units from site and replace with new.
- G. Sequence exterior lighting installation with other work to reduce possibility of damage and soiling of fixtures during the remainder of the construction period.

1.7 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, signed by Manufacturer and Installer agreeing to replace external parts of luminaires and poles exhibiting a failure of finish as specified below. This warranty is in addition to, and not a limitation of, other rights and remedies Owner may have under requirements of the Contract Documents.
 - 1. Protection of Metal from Corrosion: Warranty against perforation or erosion of finish due to weathering.
 - 2. Color Retention: Warranty against fading, staining, and chalking due to effects of weather and solar radiation.
 - 3. Warranty Period: Manufacturer's standard, but not less than three years from date of Substantial Completion for poles, and not less than one year from date of Substantial Completion for luminaires.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Glass and Plastic Lenses and Covers: 1 for every 10 of each type and rating installed. Furnish at least one of each type.
 - 2. LED Boards and Drivers: 1 for every 10 of each type and rating installed. Furnish at least two of each type.

1.9 COORDINATION

- A. Furnish bolt templates and pole mounting accessories to installer of pole foundations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include the products indicated in this Specification.

- B. Data listed and model numbers shown in this Specification for each fixture type indicate minimum requirements; and no exceptions will be made.

2.2 LUMINAIRES

- A. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- B. Metal Parts: Free from burrs, sharp corners, and edges.
- C. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- D. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position. Provide for door removal for cleaning or replacing lens. Arrange to disconnect ballast when door opens.
- F. Exposed Hardware Material: Stainless steel or as indicated on the Drawings.
- G. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
- H. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- I. Lenses and Refractors: Materials as indicated. Use heat- and aging-resistant, resilient gaskets to seal and cushion lens and refractor in luminaire doors.
- J. Lamps: Comply with the standard of the ANSI C78 series that is applicable to each type of lamp. Provide luminaires with indicated lamps of designated type, characteristics, and wattage. Where a lamp is not indicated for a luminaire, provide medium wattage lamp recommended by manufacturer for luminaire.

2.3 LUMINAIRE SUPPORT COMPONENTS

- A. Description: Comply with AASHTO LTS-3 for pole or other support structures, brackets, arms, appurtenances, base, and anchorage and foundation.
- B. Wind-Load Strength of Total Support Assembly: Adequate to carry support assembly plus luminaires at indicated heights above grade without failure, permanent deflection, or

whipping in steady winds of 100 mph (160 km/h) with a gust factor of 1.3. Support assembly includes pole or other support structures, brackets, arms, appurtenances, base, and anchorage and foundation. Strength Analysis: For each pole type and luminaire combination, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

- C. Finish: Match finish of pole/support structure for arm, bracket, and tenon mount materials.
- D. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 - 1. Materials: Will not cause galvanic action at contact points.
 - 2. Mountings: Correctly position luminaire to provide indicated light distribution.
 - 3. Anchor Bolts, Nuts, and Washers: Hot-dip galvanized after fabrication unless stainless-steel items are indicated.
 - 4. Anchor-Bolt Template: Plywood or steel.
- E. Pole/Support Structure Bases: As indicated on the Drawings.
- F. Provide poles with mast arms, brackets, and bases as indicated on the Drawings. Poles shall meet all requirements set forth in this Specification. Substitutions shall match exactly the characteristics of the pole specified in this Specification.
- G. Mast arms and pole-top mounting brackets for luminaires shall be manufactured specifically for the pole and luminaire submitted.
- H. Coordinate with pole and luminaire manufacturers for assembly details, wind-loading and vibration analysis, and compatibility of materials for electrolysis-free attachment and connection.
- I. Structural and Mechanical Design: Use a safety factor of 5.0 for static and dynamic loading of load-bearing components, including cable.
- J. Concrete for Pole Foundations: Size per Drawings. Design Strength: 3000-psi (20.7-MPa), 28-day compressive strength. Provide ground rods as required. Rub concrete to a smooth finish.
- K. Handholes: Provide manufacturer's reinforced type removable weatherproof gasketed coverplate. Provide welded 2-inch (51 mm) threaded grounding lug centered approximately 12 inches above the base. Hand holes shall have a minimum clear access opening of 2-1/2-inches x 5-inches, unless otherwise noted.
- L. Base Cover: Each pole shall be provided with a two-piece base cover fabricated from the above-specified alloy. The cover shall be attached to the pole by means of tamperproof hardware.

- M. Anchor Bolts: All anchor bolts shall be fabricated of hot rolled special quality carbon steel with minimum 50,000 psi yield strength, or as recommended by Manufacturer. Bolts shall be furnished with nuts and washers. All bolts and hardware shall be zinc electro-plated after fabrication.

2.4 FIXTURES

A. Fixture: Type SA

1. Voltage: 120V-AC
2. Mounting: Pole mounted.
3. Nominal Dimensions: 23 ½" x 15" x 4-1/2".
4. Lamp: (6) Multi-chip, 13 watt high-output, long-life LEDs.
5. Driver: Three (3) drivers, constant-current, class 2.
6. Construction: Die-cast, aluminum housing, lens frame and mounting arm. High temperature silicone gaskets. Forward throw type III distribution. UL wet location labeled. Pole shall be 15 foot (height to match existing poles) 4" square straight to match existing.
7. Finish: Factory finished Bronze, textured.
8. Manufacturer:
 - a. RAB Lighting ALED3T78N (To match existing LED parking lot luminaire and pole)
 - b. No other manufacturer accepted

B. Fixture: Type SB

1. Voltage: 120V-AC
2. Mounting: Pole mounted.
3. Nominal Dimensions: 23 ½" x 15" x 4-1/2".
4. Lamp: (2) sets of six (6) Multi-chip, 13 watt high-output, long-life LEDs.
5. Driver: (2) sets of three (3) drivers, constant-current, class 2.
6. Construction: Die-cast, aluminum housing, lens frame and mounting arm. High temperature silicone gaskets. Forward throw type III distribution. UL wet location

labeled. Pole shall be 15 foot (height to match existing poles) 4” square straight to match existing.

7. Mounting: Mount 180 degrees a part.
8. Finish: Factory finished Bronze, textured.
9. Manufacturer:
 - a. RAB Lighting ALED3T78N (To match existing LED parking lot luminaire and pole)
 - b. No other manufacturer accepted.

C. Fixture: Type SC

10. Voltage: Multi-tap (120, 208, 240, 277V)
11. Mounting: In-grade
12. Nominal Dimensions: 12” diameter x 16”
13. Lamp: 22 watt monochromatic LEDs, 53k white.
14. LED Driver: Encapsulated in heat dissipating epoxy power section.
15. Construction: Cast aluminum door. Injection molded polymer rough-in section that houses the lamp and power sections. Lamp section is stainless steel housing factory –sealed and purged of all moisture, flat lens clear with 10 degree tilt. UL wet location rated.
16. Optical System: Spot distribution
17. Manufacturer:
 - a. Hydrel M9710 Series

2.5 FINISHES

- A. Comply with NAAMM's *Metal Finishes Manual for Architectural and Metal Products* for recommendations for applying and designating finishes.
- B. Provide finishes on poles, mounting arms/brackets, and luminaires as indicated in the Lighting Fixture Schedule.

2.6 SPLICES, TAPS

- A. All splices underground in hand holes or other wet locations shall be waterproof and made with Scotchcast 85 Multi-Mold Splicing Kits, or approved equal.
- B. All taps in pole bases shall use suitable connectors such as Burndy Type K's and taped with two layers of 3M Scotch Brand or approved equal rubber tape and six layers of vinyl plastic electrical tape. Tap wiring to luminaire shall incorporate Bus type HEB waterproof in line fuseholder with this as recommended by ballast manufacturer and #12 XHHW conductors.
- C. Splices in hand holes shall be supported on bricks 8-inches above bottom of handhole. Splices shall be kept to a minimum and are prohibited in locations other than hand holes, pull boxes or lighting unit bases, except for retaining circuitry of existing underground wiring where existing poles or wiring are distributed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which roadway, parking and outdoor lighting fixtures are to be installed and substrate which will support lighting fixtures. Notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.2 FIELD COORDINATION

- A. The Contractor shall be responsible for all field coordination, including verification of property lines, right of ways and other utilities.
- B. Contractor shall locate poles and underground conduits within property lines. Contractor shall locate poles in compliance with local setback requirements.

3.3 DEMOLITION

- A. Remove all existing lighting poles, fixtures, bases, and wiring which are indicated to be removed on the Drawings, and/or are obstacles to construction.
- B. Re-use lighting poles and/or luminaires indicated to be relocated on the Drawings.
- C. Turn over any removed lighting poles and/or luminaires that are not being relocated/re-used to the Owner.

3.4 INSTALLATION

- A. Concrete Foundations: Construct concrete foundations with 3000 pound, 28-day concrete.
 - 1. Comply with details for reinforcement and for anchor bolts, nuts, and washers. Verify anchor-bolt templates by comparing with actual pole bases furnished.
 - 2. Finish for Parts Exposed to View: Trowel and rub smooth. Comply with Division 03 Section *Cast-in-Place Concrete* for exposed finish.

- B. Install poles in compliance with ANSI C2, with Manufacturer's written instructions and as follows:
1. Use web fabric slings (not chain or cable) to raise and set poles.
 2. Mount pole to foundation with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
 3. Secure poles level, plumb, and square. Provide shimming and grouting of pole base to maintain luminaire in a true vertical position.
 4. Grout void between pole base and foundation. Use nonshrinking or expanding concrete grout firmly packed in entire void space.
 5. Use a short piece of 1/2-inch- (13-mm-) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- C. Luminaire Attachment: Fasten to indicated structural supports.
- D. Luminaire Attachment with Adjustable Features or Aiming: Attach luminaires and supports to allow aiming for indicated light distribution.
- E. Lamp luminaires with indicated lamps according to manufacturer's written instructions. Replace malfunctioning lamps.
- F. Install exterior lighting fixtures at locations and heights as indicated in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's *Standard of Installation*, NEMA Standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.

3.5 UNDERGROUND DUCT LINES

- A. Duct lines shall be polyvinylchloride (PVC) heavy wall plastic ducts for installation without concrete encasement. Where local codes do not prohibit, ducts may be supplied with pre-assembled conductors.
- B. Conductors AWG size shall be as indicated on the drawings, minimum number 10 AWG. Conductors shall be type THW. Provide for each 2-wire circuit shown on the drawings a separate green grounding conductor sized in accordance with NEC. Connect to lighting standard as required.
- C. Duct lines shall be installed in a trench minimum 30 inches below grade. Trench shall be cleaned of all rock, gravel or debris larger than 1/4 inch diameter. Duct lines shall rest on minimum 3-inch clean sand bed and shall have minimum 3 inches clean sand over cover. Trench earth backfill shall be free of rock, gravel or other debris. Open trenches shall be limited to 30 linear feet before backfilling.
- D. Metal conduit sleeves of sufficient size shall be installed in concrete lighting standard bases to allow the entry/exit of branch circuit wiring. Sleeves shall be capped with bushings.

- E. All elbows and all ducts installed above grade shall be rigid galvanized steel.

3.6 GROUNDING

- A. Ground fixtures and metal poles according to Division 26 Section, “Grounding and Bonding”.
 - 1. Ground metallic components of lighting fixtures, poles, and foundations. Connect luminaires to grounding system with No. 4 AWG conductor.
 - 2. Install 10-foot (3-m) driven ground rod at each pole, exothermically welded to grounding conductor.

3.7 CONNECTIONS

- A. Ground equipment: Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Ground metal poles/support structures according to Division 26 Section “Grounding and Bonding” and per this Section, Paragraph “Grounding”.

3.8 FIELD QUALITY CONTROL

- A. Inspect each installed unit for damage. Replace damaged units.
- B. Advance Notice: Give dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests and Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source, and as follows:
 - 1. Measure light intensities at night if specific illumination performance is indicated. Use photometers with calibration referenced to NIST standards.
 - 2. Check intensity and uniformity of illumination.
 - 3. Check excessively noisy ballasts.
- E. Prepare a written report of tests, inspections, observations and verifications indicating and interpreting results.
- F. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.
- G. Set, adjust, and aim adjustable fixtures at night. Repeat procedure until units provide illumination acceptable to the Owner.

- H. Provide for the replacement/restoration of lamps in exterior lighting fixtures, where used for temporary lighting prior to Date of Substantial completion.
- I. At the Date of Substantial Completion, replace lamps in exterior lighting fixtures which are observed to be noticeably dimmed after Contractor's use and testing, as judged by the Architect.

3.9 CLEANING AND ADJUSTING

- A. Clean units after installation. Use methods and materials recommended by manufacturer.
- B. Adjust aimable luminaires and luminaires with adjustable lamp position to provide required light distributions and intensities, in night test of system. Verify that measured illuminance values comply with isolux plot diagram values and point-by-point calculations.
- C. Touch up damage to finishes.

3.10 DEMONSTRATION

- A. Provide a minimum of four (4) hours of demonstration of luminaire operation.
- B. Upon completion of installation of exterior lighting fixtures and associated electrical supply circuitry, apply electrical energy to circuitry to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

3.11 LAMP REPLACEMENT AND PROVISION OF SPARE LAMPS

- A. At time of substantial completion, replace lamps in luminaires which are observed to be not functioning properly after Contractor's use and testing at the discretion of the Engineer.
- B. Provide stock or replacement lamps as specified in this Section, Paragraph "Extra Materials".

END OF SECTION

DIVISION 28
SECTION 28 31 12
FIRE ALARM SYSTEM – EXISTING SYSTEM UPGRADES

- PART 1 GENERAL
 - 1.1 GENERAL
 - 1.2 APPLICABLE PUBLICATIONS
 - 1.3 SCOPE

- PART 2 PRODUCTS
 - 2.1 FIRE ALARM DEVICES

- PART 3 EXECUTION
 - 3.1 GENERAL
 - 3.2 SYSTEM TESTING
 - 3.3 WARRANTY

CANNOT BE USED FOR BIDDING

SECTION 28 31 12 - FIRE ALARM SYSTEM

PART 1 GENERAL

1.1 GENERAL

- A. This section of the specification includes the furnishing, assembly, construction, installation, connection and testing of a complete fire alarm system as described herein and on the drawings. The system is subject to the requirements of the *Common Work Results for Electrical* section of this specification.
- B. All related work specified in other sections shall be properly coordinated with the fire alarm equipment.
- C. The additions to the system shall include all wiring, raceways, pull boxes, terminal cabinets, outlet and mounting boxes, alarm initiating devices, alarm indicating devices, and control equipment, and all other accessories and miscellaneous items required for an operating system.
- D. Qualification of Installer: The system shall be installed by an electrical contractor experienced in the installation of the fire alarm system. The services of a technician provided by the control equipment manufacturer shall be provided to supervise installation, adjustment, and tests and final connections of the system.

1.2 APPLICABLE PUBLICATIONS

- A. Unless otherwise indicated, the system and its components specified, and their installation and operation shall conform to the latest applicable requirements of the following publications:
 - 1. National Fire Protection Association (NFPA):
 - NFPA 70 National Electrical Code
 - NFPA 72E Automatic Fire Detectors
 - NFPA 90A Air Conditioning and Ventilating Systems
 - NFPA 72A Standard for the Installation, Maintenance and Use of Local Protection Signaling Systems
 - NFPA 101 Codes for Life Safety from Fire in Buildings and Structures
 - 2. Underwriters Laboratories (UL):
 - Fire Protection Equipment Directory
 - Electrical Construction Materials Directory
 - 3. Factory Mutual Approval Guide
 - 4. American Insurance Association Fire Protection Code (Article 14)
 - 5. State of Delaware Fire Protection Regulations.

- B. Acceptable evidence of compliance of components is a UL or FM label or listing or an independent certification, satisfactory to the Engineer, that the components meet the applicable standards.

1.3 SCOPE

A. WORK INCLUDED

1. Furnish and install all additional fire alarm system wiring devices as indicated on the drawings.
2. Provide all required upgrades to the existing fire alarm system equipment to accommodate the additional fire alarm devices.
3. All fire alarm devices shall be connected to the existing Notifier SFP-100D Fire Alarm System.

B. Provide equipment submissions including the following:

1. Complete descriptive data for all items/devices provided.
2. Complete drawings of the proposed system showing conduit layout, wire count and device locations.

C. Detection Operation (Ceiling)

1. Smoke sensors shall be smoke density measuring devices having no self contained alarm set point (fixed threshold). The alarm decision for each sensor shall be determined by the control panel. The control panel shall determine the condition of each sensor by comparing the sensor value to the stored values.

PART 2 PRODUCTS

2.1 FIRE ALARM DEVICES

- A. Provide new smoke detectors that are compatible with existing Notifier SFP-100D Fire Alarm Control Panel.
- B. Provide new manual pull stations that are compatible with existing Notifier SFP-100D Fire Alarm Control Panel.
- C. Provide new audible/visual and visual alarms that are compatible with existing Notifier SFP-100D Fire Alarm Control Panel.
- D. Provide connections to new door strikes that are compatible with existing Notifier SFP-100D Fire Alarm Control Panel.

PART 3 EXECUTION

3.1 GENERAL

- A. Provide and install the additions to the system in accordance with the plans and specifications, all applicable codes and the manufacturer's recommendations. All wiring shall be installed in strict compliance with all the provisions of NEC -Article 760 A and C, Power-Limited Fire Protective Signaling Circuits or if required may be reclassified as non-power limited and wired in accordance with NEC-Article 760 A and B. Upon completion, the contractor shall so certify in writing to the owner and general contractor. All junction boxes shall be sprayed red and labeled *Fire Alarm*. Wiring color code shall be maintained throughout the installation.
- B. Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate subcontractors.
- C. Ensure that the final mounting location will provide convenient access to the enclosure for maintenance.

3.2 SYSTEM TESTING

- A. The completed fire alarm system shall be fully tested by the contractor and the manufacturer's NICET CERTIFIED technical representative in the presence of the owner's representative. Upon completion of a successful test, the contractor shall so verify in writing to the Owner, and general contractor.
- B. The following test shall be performed by the Fire Alarm Manufacturer's authorized representative. Each and every device shall be tested for it's intended function. Verify that each device is located in its appropriate location. Written verification of this test shall be provided to the owner, architect, and general contractor. This test shall be performed in accordance with NFPA 72 National Fire Alarm Code.

3.3 WARRANTY

- A. The equipment and wiring shall be warranted to be free from electrical and mechanical defects for a period of two (2) years commencing with start-up and owners beneficial use of any portion of the system. Warranty shall include all labor/travel time and parts.

END OF SECTION

DIVISION 200 EARTHWORK

SECTION 201 - CLEARING AND GRUBBING

201.01 Description. This work consists of clearing, grubbing, removing, and disposing of all vegetation and debris within the limits of construction unless otherwise indicated, except such objects as are designated to remain or are to be removed in accordance with other Sections of these Specifications. This work also includes the preservation from injury or defacement of all vegetation, trees, and objects designated to remain.

CONSTRUCTION METHODS.

201.02 General. The Contractor shall remove only material herein specified. If the Contractor chooses to do such work with mechanical equipment, and removes and wastes suitable embankment and topsoil material required on the Project, any suitable embankment and topsoil material removed with the cleared and grubbed material shall be replaced by the Contractor.

The Department reserves the right to require the Contractor to use a root rake if large quantities of suitable embankment and topsoil material is being wasted during the grubbing operation.

All arboriculture practices for tree care operations shall be conducted in accordance with ANSI Z133.1 as prepared by the International Society of Arboriculture.

201.03 Trees Designated to Remain. The Engineer shall designate such trees, shrubbery, and plants which are not to be removed, and the Contractor shall protect them from any damage. If any such trees, shrubbery, or plants are damaged, they shall be replaced or repaired by a certified tree surgeon. Branches of trees overhanging the roadbed shall be properly trimmed to maintain a clearance height of 20' (6 m), unless otherwise directed. All pruning shall be performed in accordance with the International Society of Arboriculture's Current Tree Pruning Guidelines, Publication ISBN 1-881956-07-5, and as illustrated on the Standard Construction Details.

201.04 Disposal. All materials removed by the clearing and grubbing operation shall become the property of the Contractor and shall be removed from the Project or otherwise disposed of as specified in Subsection 106.09.

201.05 Preparation of Ground Surface. Grading operations shall not be started in any area until all operations of clearing and grubbing work within the area affected have been completed. In areas where excavation is to be made, the ground shall be cleared of all living or dead trees, stumps, brush, or other objectionable material. All embedded stumps, root mats, etc., shall be removed to a depth of not less than 2' (600 mm) below the subgrade or slope surfaces. All depressions made below the subgrade or slope surfaces by the removal of stumps or roots shall be backfilled with approved material and compacted as directed. In areas where embankment is to be made 5' (1.5 m) or more in depth, where depth is measured from the bottom of the fill to the subgrade, trees and stumps shall be cut off as close to the ground as is practicable, but not to exceed 6" (150 mm) above the ground surface. In the area from the toe of the embankment slope to 5' (1.5 m) inside the embankment, all trees, stumps, roots, brush, root mat, and debris shall be removed.

JP COURTS 3/17
State Project #MC0213000002

In areas where embankment is to be made less than 52 (1.5 m) in depth, all trees, stumps, roots, brush, root mat, and debris shall be removed, grubbed, or blasted from the ground, in their entirety. Root mat shall be removed to the following depths unless otherwise indicated in the Contract:

- | | |
|---|-----------------|
| (a) Forested areas (within tree line shown on the Plans): | 2' (600 mm) |
| (b) Scrub wooded areas: | 1' (300 mm) |
| (c) Field areas: | vegetation only |

Clearing, grubbing, and excavation to permit installation of necessary ditches and sediment controls shall be done prior to clearing and grubbing the remainder of the Contract. Based on soil conditions encountered after completion and acceptance by the Engineer of the applicable clearing and grubbing, topsoil removal, and ditching, the Engineer may direct the Contractor to withhold all earthmoving activities for a maximum of 14 calendar days to allow for drying and solidification of the ground.

201.06 Clearing and Grubbing Limitations. The Engineer reserves the right to limit clearing and grubbing operations in order to ensure compliance with the applicable erosion and sediment control regulations.

The maximum exposed surface area of erodible soil, due to clearing and grubbing operation, shall be 20 ac (8 ha).

201.07 Clearing Outside the Limits of Construction. All trees that interfere with sight distance, either vertically or horizontally, shall be cleared from the right-of-way and easement areas. If noted in the Contract, right-of-way and easement areas shall be cleared, flush with the ground, of all trees, brush, shrubs, downed timber, rotten wood, rubbish, and other objectional debris and vegetation.

201.08 Removal of Other Obstructions. Fences and guardrail upon or within the limits of construction, shall be removed carefully by the Contractor, wholly or in part, as specified or directed, and disposed of as specified or directed, except as otherwise indicated in the Contract. Buildings and other structures shall be removed by the Department or other responsible authority unless otherwise provided. Footings, pipes, conduits, drainage inlets and grates, and similar items which are located beneath the ground surface are not to be removed under Section 201.

SECTION 202 - EXCAVATION AND EMBANKMENT

202.01 Description. This work consists of the removal and final disposal of all materials taken from within the limits of construction as necessary for the preparation and construction of the roadbed, embankments, subgrades, shoulders, slopes, side ditches, approaches, intersecting roads, and private

entrances. Flexible pavement shall be removed under this Section. The removal and final disposal of materials specified under other pay items is not included in this work.

This work also consists of grading and compacting of the embankment, roadway, and shoulders; construction, shaping, and sloping of side ditches, embankment, and cut slopes; construction and maintenance of temporary edge berms, interceptor berms, and embankment slopes associated with all erosion control methods indicated in Section 261; undercutting, which is the removal of unsuitable material below the grade of a proposed subgrade or embankment foundation; salvaging and stockpiling of topsoil for re-use; backfilling of areas from which unsuitable materials have been removed; and the removal and disposal of all material not otherwise provided for, so that the Project is completed in a neat workmanlike manner.

CONSTRUCTION METHODS.

202.02 Test Rolling. Test rolling shall be performed with self-propelled, pneumatic-tired equipment, which shall be of the size, type, and weight that will reveal any soft, yielding, or spongy areas. The equipment shall be run longitudinally with less than 18" (500 mm) of unrolled area between tire strips. If the test rolling shows the subgrade to be unstable, the Contractor shall scarify, disc, aerate, or add moisture, and recompact the subgrade to the extent necessary to achieve stability. Acceptance of the test roll by the Engineer will be a requirement prior to placement of subsequent lifts. The test roll shall be performed with a fully loaded, ten-wheel dump truck or other equipment approved by the Engineer. The test roll shall serve to verify the stability of the lift in question, and no compaction tests will be taken until the stability of the lift is determined to be satisfactory by the Engineer.

202.03 Excavation. Excavation shall be made in accordance with these Specifications, the Plans, or as established by the Engineer. No allowance will be made for materials excavated beyond or below the lines and grades shown. All suitable material removed as excavation shall be used in the formation of embankments, shoulders, and slopes, before securing or imputing any borrow, unless specifically approved by the Engineer. No unsuitable material will be allowed in the formation of embankment. Unsuitable materials shall be deposited on slopes as directed or shall be disposed of when directed. All existing ditches and waterways, and all new or existing pipes and culverts, unless noted on the Plans to be abandoned, shall be cleaned and cleared of obstructions and shall be left in a neat and trimmed condition.

- (a) *Obstructions.* The Contractor shall remove and properly dispose of pipes, drainage inlets, pole bases, conduits, and any other articles located below existing ground level.
- (b) *Disposal.* All waste materials removed by the excavation operation shall become the property of the Contractor and shall be removed from the Project or otherwise disposed of as specified in Subsection 106.09.
- (c) *Topsoil.* Topsoil, if present, shall be removed in its entirety from all cut sections and from fill sections where embankment heights are less than 5' (1.5 m) when measured from bottom of fill to subgrade.

Sufficient topsoil shall be stockpiled to meet the requirements of Section 733.

For projects where excavation generates excess fill material, remaining topsoil shall be removed from the site and taken to an approved disposal area or shall be retained by the State.

For projects in which embankments are constructed, remaining topsoil shall be incorporated in the outer portions of embankment as shown in the Contract. After all

EXCAVATION AND EMBANKMENT

202

embankment needs have been met, any remaining topsoil shall be removed from the site and taken to an approved disposal area or shall be retained by the State.

Excess topsoil may be claimed by the Engineer. In such cases, the Contractor shall load State vehicles for its removal. If the State wishes to claim excess topsoil, such direction will be given to the Contractor prior to the start of earth-moving operations.

- (d) *Excess Material Stockpiled for Later Use.* If ordered by the Engineer, excess material that cannot be immediately placed in fill areas shall be stockpiled at a location within the Project limits designated by the Engineer, for later use, thus requiring double handling. At the time when stockpiled excess material is to be used in fill areas or for the formation of embankments, shoulders and slopes, it shall be loaded and hauled by the Contractor and placed and compacted as specified in Subsection 202.05. The requirements of this paragraph also apply to excess materials generated from hot-mix removal, incidental concrete removal, and all construction materials which can be used for fill material.
- (e) *Excess Material Generated From Other Pay Items.* If ordered by the Engineer, excess materials generated from other pay items which are suitable for embankment purposes shall be placed in fill areas. If the material being excavated can immediately be moved to fill areas for placement, it shall be placed and compacted in accordance with Subsection 202.05. If the material cannot be immediately placed in fill areas, then it shall be stockpiled, and reused at a later time according to (d) above.
- (f) *Excess Material Generated by Others.* Excess material generated by others, including other Contractors or utility companies and their Contractors performing work within the Contract limits shall be separately stockpiled for later use in accordance with Subsection 202.03 (d).

202.05 Embankment. All embankments shall be formed of material meeting the requirements of Section 209, except that rock, bituminous concrete, or portland cement concrete, obtained from the excavation, may be used if placed in uniform loose layers of 24" (600 mm) or less. Any exposed rebar shall be cut and disposed of. All material which cannot be readily incorporated into a 24" (600 mm) loose layer shall be reduced in size to meet this requirement. Individual pieces of rock, bituminous concrete, or portland cement concrete shall not exceed 36" (900 mm) in any dimension. No rock, bituminous concrete, or portland cement concrete shall be placed within 5' (1.5 m) of the top of the embankment when measured from the top surface of rock, bituminous concrete, or portland cement concrete to the bottom of the pavement structure. Embankment materials placed in pile foundation areas where piles are to be placed shall contain no rock, aggregate, broken concrete, or other material which would be retained on a 2½" (63 mm) sieve. No spongy, wet, or frozen material will be permitted in the embankment. Excessive or insufficient mixture content shall not be criteria for classifying materials as unsuitable for embankment. The Contractor shall make the necessary effort to wet or dry the mixture in order to comply with Subsection 202.05 (f).

- (a) *Preparation.* Unless shown otherwise on the Plans or in the Special Provisions, where the embankment height to be constructed is less than 5' (1.5 m), all sod, vegetation, and topsoil shall be removed from the surface upon which the embankment is to be placed, and the cleared surface shall be completely broken-up to a minimum depth of 6" (150 mm). This area shall then be recompact. Sod not required to be removed shall be thoroughly disced before construction of embankment.

Existing treated or compacted road surfaces lying within 3' (900 mm) of the final grade, or within the pavement structure if the subgrade is more than 3' (900 mm) from the final grade, shall be scarified to a depth of at least 6" (150 mm), unless otherwise designated on the Plans. Scarified material shall be recompact.

Existing paved road surfaces lying within 3' (900 mm) of the final grade, or within the pavement structure if the subgrade is more than 3' (900 mm) from the final grade, shall be removed, and the underlying base materials scarified to a depth of 6" (150 mm).

Existing roadway surfaces lying more than 3' (900 mm) below the final grade, or bottom of pavement structure, shall remain in place and be treated as follows:

- (1) Bituminous concrete shall be broken up to a maximum surface area of 1 ft² (0.1 m²) and recompact.
 - (2) Portland cement concrete shall be broken up to a maximum surface area of 1 yd² (0.8 m²) with a pavement breaker or other approved equipment.
 - (3) Bituminous surface treated roadways lying beneath an embankment shall be scarified to a depth of 6" (150 mm) and recompact.
- (b) *Widening Existing Embankments.* Where new embankments are to be placed against existing embankments or the existing embankment is to be widened, the existing embankment shall be benched in accordance with the details shown on the Plans or as directed.
- (c) *Placement.* Material shall be placed in successive layers, and each layer shall be placed in a level, uniform cross-section, not to exceed 8" (200 mm) in depth, loose measurement, unless otherwise approved by the Engineer. It shall be deposited and spread parallel to the roadway centerline, and the layers shall extend the full width of the embankment. If so required, each layer shall be disced to ensure uniform distribution of moisture and component materials. Each layer shall be properly compacted, as hereinafter specified, before starting the next layer. No embankment shall be placed on any wet, unstable, or frozen materials.

However, depending on the soil conditions encountered at proposed embankment areas, the Contractor may be directed to place the first lift of embankment to a thickness greater than 83 (200 mm) in depth. All subsequent lifts shall be placed as specified herein.

Unless otherwise approved by the Engineer, the Contractor shall be required to test roll all lifts of soil, aggregate, or soil mixtures according to the requirements of Subsection 202.02. Any instability evidenced during the test roll shall be corrected to the satisfaction of the Engineer by discing, aerating, recompact, removing, and replacing of material. After corrective measures have been taken, test rolls to verify the stability of the lift shall be required.

At the end of each day during which the Contractor places embankment, the Contractor shall construct edge berms, interceptor berms, and embankment slopes. Temporary slope drains shall be extended to connect to the edge and interceptor berms.

- (d) *Compaction Equipment.* There shall be sufficient equipment of the proper type and weight provided to do the work of grading, leveling, and compacting promptly after depositing the material. When this equipment is inadequate for the rate of compacting, the rate of excavation or placing of embankment shall be reduced to a rate not to exceed the capacity of the grading and compacting equipment.

Compaction shall be attained by approved rollers or compactors. The use of other suitable compaction equipment may be approved for work under Section 202 provided such equipment is configured and operated so that the requirements of these Specifications are fully met.

- (e) *Compaction Procedure.* Compaction or rolling shall start at the edges, progress toward the center of the embankment, and shall continue until each layer is thoroughly and uniformly compacted to the full width of the embankment and to 95% or more of the maximum density of the same soils as determined by AASHTO T 99 Method C, Modified.

The ordinary use of trucks, carryalls, scrapers, tractors, or other construction equipment may be considered as rolling, but the traffic of such hauling equipment shall be distributed over the fill in such a manner that makes use of the compaction provided by the construction equipment.

All areas of sharp depressions, trench backfills, and around culverts, bridges, and walls, inaccessible to the specified methods of compaction, shall be built in continuous horizontal layers not more than 8" (200 mm) in depth, loose measurement, and shall be thoroughly tamped and compacted to the specified density.

Properly broken rock, bituminous material, or portland cement concrete shall be compacted with a minimum of six passes of an approved roller or as otherwise directed.

- (f) *Density and Moisture Control.* The determination of compliance with field compaction requirements, as specified herein, shall be in accordance with the following AASHTO test methods:

- (1) AASHTO T 191, T 238, and T 239, Modified. Field density tests shall be expressed as a percentage of the maximum density made on the same soils.
- (2) AASHTO T 99 Method C, Modified, for determination of maximum density and optimum moisture content.
- (3) AASHTO T 224, Modified, by coarse particle correction method.

The moisture content of the soil at the time of compaction shall be within 2% of the optimum moisture content, as determined by AASHTO T 99 Method C, Modified.

If the moisture content is not within 2% of optimum, the soil shall be either moistened or dried and thoroughly mixed to the proper moisture content before compaction.

No compaction or moisture tests shall be taken, unless specifically requested by the Engineer, until the stability of the lift to be tested has been approved by the Engineer.

202.06 Preparation of Subgrade. The subgrade shall be maintained in such condition that it drains. Prior to the formation of the final subgrade, or of the cutting of any section for the pavement structure in which the subbase or base is to be placed, all side ditches parallel to the centerline of the roadway shall be cut to their plan gradient and vegetatively stabilized to prevent scour and erosion. Temporary ditches permitting drainage from the cut for the pavement structure to the side ditches shall be provided at intervals as required. All facilities necessary for complete drainage of the construction area shall be provided and maintained by the Contractor. The Contractor shall provide for the control of sediment and erosion for all water drained or pumped from the subgrade in accordance with Section 110.

In no case shall vehicles be allowed to travel in a single track and form ruts in the subgrade. If any sharp irregularities are formed, the subgrade shall be scarified and recompacted.

- (a) *Cut Section.* The subgrade shall be properly shaped and uniformly and thoroughly compacted, in conformity with the lines and grades shown on the Plans or as established in the field, before any subbase, base, or surfacing material is placed. The subgrade shall be free from boulders, large rocks, muck, vegetation, or other materials that would prove detrimental to the road's stability. Depressions that develop during the rolling shall be filled with suitable material, and the subgrade shall be rolled until no depressions continue to develop.

Where excavation to the finished graded section results in a subgrade or slopes of unsuitable material, the Engineer may require the Contractor to remove the unsuitable material and backfill to the finished graded section with approved material in accordance with Section 212. The Contractor shall conduct its operations in a manner that allows the Engineer to take the necessary cross-sectional measurements before the backfill is placed.

- (b) *Fill Section.* Prior to placement of any base material, the subgrade and adjacent shoulder or slope rounding earthwork shall be completed to their finished grade elevation in order to form a box to retain the base material. No base material shall be placed in a section where a box has not been created unless specifically approved by the Engineer.

202.07 Approval of Subgrades. No subbase or base materials shall be placed until the subgrade has been approved.

202.09 Dust Control. Adequate dust control must be maintained by the Contractor at all times during the earth-moving operations. Dust shall be controlled exclusively through the use of water unless otherwise indicated in the Contract documents or authorized by the Engineer.

SECTION 207 - EXCAVATION AND BACKFILLING FOR STRUCTURES

207.01 Description. This work consists of the excavation, removal, and replacement or disposal of all materials necessary for the construction of box and pipe culverts, pipe headwalls, bridge structures, bridge approach slabs, and other structures. This work also consists of placing and compacting backfill material; furnishing and placing of shoring, sheeting, bracing, and cofferdams; and dewatering of these areas, unless otherwise specified.

CONSTRUCTION METHODS.

207.02 Foundation Pits. Foundation pits shall be excavated to the depths shown on the Plans, or to such depth as required to ensure the stability of the structure to be erected, or as directed by the Engineer.

207.03 Excavation. Excavation shall be sufficient in volume to place the full widths, thicknesses, and lengths of footings. Undercutting of edges, ends, corners, and other surfaces will not be permitted. If a sump area is required to keep the excavation dry during construction, it shall be outside the footing line.

All suitable materials removed during excavation shall be used, as far as practicable, in the formation of roadway embankments, or as structure backfill if it meets the requirements of Subsection 207.05. No excavated material shall be wasted without permission. Boulders, logs, structure remnants, or other obstructions shall be considered unsuitable materials. All unsuitable and excess material shall be disposed of as specified in Subsection 106.09, or as directed.

When the excavation is completed, the Engineer will make an inspection of the footing area. No concrete shall be placed until the depth and character of the foundation material are approved.

207.05 Backfilling. All backfilling of structures shall conform to the requirements of Subsection 202.05 (c), (d), and (e). Unless otherwise specified, all backfilling around and over structures shall be performed with material conforming to the requirements of Subsection 209.04, Borrow Type C. Backfill material shall be compacted to 95% or more of the maximum density according to the requirements of Subsection 202.05 (f). When backfilling next to bridges, culverts, or other structures, no heavy mechanical compacting equipment will be permitted over the structure until a minimum of 18" (450 mm) of cover has been placed.

Backfill adjacent to rigid frames, arches, timber structures, and other similar structures shall be brought up simultaneously at each abutment, so that no unbalanced stresses are introduced.

SECTION 208 EXCAVATION AND BACKFILLING FOR PIPE TRENCHES

208.01 Description. This work consists of the excavation, removal, and replacement or disposal of all materials necessary for the placement of pipes.

This work also consists of placing and compacting backfill for pipe trenches.

CONSTRUCTION METHODS.

208.02 Test Holes and Test Pits. All test holes and test pits shall be excavated under this Section. They shall be dug with extreme care, using hand excavation methods where necessary.

208.03 Excavation. Unsuitable foundation material shall be removed from below the bottom of trench elevation shown on the Plans, or as directed.

When a pipe is to be placed either partially or completely in a fill, the embankment shall be compacted to an elevation of 12" (300 mm) plus the outside diameter of the pipe above the design invert of the pipe for a minimum of two pipe diameters on each side of the centerline of the pipe. The trench shall then be excavated, as specified in this Subsection.

When rock, hardpan, or other unyielding material is encountered, the trench shall be excavated as shown on the Plans and in accordance with Subsection 206.03.

208.04 Backfilling. All backfilling of pipe trenches shall conform to the requirements of Subsection 202.05 (c), except proof rolling will not be required.

For pipe trenches or utility trenches below the roadway or shoulders, trenches shall be backfilled with material conforming to the requirements of Subsection 209.04, Borrow Type C. If the existing material meets these requirements, it shall be used for pipe or utility backfill. For these areas, backfill material shall be compacted to 95% or more of maximum density according to the requirements of Subsection 202.05 (f). For pipe trenches or utility trenches at locations other than below the roadway and shoulders, trenches shall be backfilled with material conforming to the requirements of Subsection 209.04, Borrow Type C, to a height of 12" (300 mm) above the top of the pipe or utility. The remaining depth of these pipe or utility trenches shall be backfilled with existing material. For these areas, backfill material shall be compacted to 90% or more of the maximum density according to the requirements of Subsection 202.05 (f).

Material for backfilling utility trenches shall be furnished by the Contractor. Materials shall be stockpiled at location(s) mutually agreed upon by the Contractor, the utility, and the Engineer. The operation of backfilling utility trenches shall be performed by the utility organizations involved and shall conform to the requirements of Section 202.05 (c).

Utility companies will be required to remove all excess excavation material from the Project, unless the Engineer directs it to be utilized by the Contractor in the Project.

SECTION 209 BORROW

209.01 Description. This work consists of furnishing and placing additional material from approved borrow areas or other approved sources when suitable material available within the right-of-way is not sufficient in quantity for construction purposes. This work also includes all clearing, grubbing, or stripping required to prepare the borrow area for cross-sectioning and excavating.

MATERIALS.

209.02 General Requirements. The uses, classifications, characteristics, and definitions of terms for borrow materials shall be in accordance with the requirements of AASHTO M 57, Modified; M 145, Modified; and M 146 and M 147, Modified.

Unless otherwise directed, all materials having the following properties shall be excluded from use:

- (a) Material with a maximum dry weight less than 90lb/ft³ (1440 kg/m³).
- (b) Material with a liquid limit greater than 50.
- (c) Material containing frozen material, rubbish, boulders in excess of 6" (150 mm) in any direction, or organic matter such as leaves, roots, grass, or sewage.

209.03 Materials Testing. The method of testing materials shall be in accordance with the requirements of AASHTO T 88, Modified; T 89, Modified; T 90, Modified; and T 99 Method C, Modified.

209.04 Borrow Types. The following types of borrow are subject to the requirements of this Section.

- (a) *Borrow Type A.* This material shall have between 95 and 100% inclusive, by dry weight, passing a 2½" (63 mm) sieve and a maximum of 35%, by dry weight, passing a No. 200 (75 µm) sieve.

- (b) *Borrow Type B (Special Fill).* This material shall have 100%, by dry weight, passing a

JP COURTS 3/17

State Project #MC0213000002

3" (75 mm) sieve and a maximum of 10%, by dry weight, passing a No. 200 (75 µm) sieve.

- (c) *Borrow Type C (Backfill)*. This material shall have between 85 and 100% inclusive, by dry weight, passing a 1" (25.0 mm) sieve and a maximum of 25%, by dry weight, passing a No. 200 (75 µm) sieve.
- (d) *Borrow Type D (Cement Stabilization)*. This material shall have 100%, by dry weight, passing a 3" (75 mm) sieve and between 8 and 30% inclusive, by dry weight, passing a No. 200 (75 µm) sieve.
- (e) *Borrow Type E (Asphalt Stabilization)*. This material shall have 100%, by dry weight, passing a 3" (75 mm) sieve and between 6 and 20% inclusive, by dry weight, passing a No. 200 (75 µm) sieve. This material shall be non-plastic.
- (f) *Borrow Type F (Common Borrow)*. This material shall meet the general requirements as specified in Subsection 209.02.
- (g) *Borrow Type G (Select Borrow)*. This material shall meet any of the grading requirements listed in the following table:

Table 209-A
Type G* (Select Borrow)

<u>Sieve Designation</u> U.S. Customary	<u>Sieve Designation</u> Metric	<u>Dry Weight Percent Passing Square Mesh Sieves</u>					
		Grading I	Grading II	Grading III	Grading IV	Grading V	Grading VI
2"	50 mm	100	100	95 – 100	95 – 100	95 – 100	95 – 100
1"	25.0 mm	---	75 – 95	85 – 100	85 – 100	85 – 100	85 – 100
3/8"	9.5 mm	30 - 65	40 – 75	50 – 85	60 – 100	---	---
No. 4	4.75 mm	25 – 55	30 – 60	35 – 65	50 – 85	55 – 100	70 – 100
No. 10	2.0 mm	15 – 40	20 – 45	25 – 50	40 – 70	40 – 100	55 – 100
No. 40	425 µm	8 – 20	15 – 30	15 – 30	25 – 45	20 – 50	30 – 70
No. 200	75 µm	2 – 8	5 – 20	5 – 15	5 - 20	6 – 20	8 - 25

* The fraction passing a No. 200 (75 µm) sieve shall not be greater than two-thirds of the fraction passing a No. 40 (425 µm) sieve. The fraction passing a No. 40 (425 µm) sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 6, when tested according to AASHTO T 89, Modified, and AASHTO T 90, Modified.

CONSTRUCTION METHODS.

209.05 Borrow Sources. The Contractor shall notify the Department's Materials and Research Section at least ten working days in advance of material being removed from any borrow source so that samples may be obtained and tested prior to use. The limits of approved material within the borrow source and the method of excavation shall be approved by the Department's Materials and Research Section. The ground surface shall be cleared and grubbed in the manner described under Section 201 and shall be stripped of all unsuitable material, as determined by the Engineer, before the excavation of any borrow. No borrow for the Contract shall be excavated within 100' (30 m) of the right-of-way lines except with written permission from the Engineer.

JP COURTS 3/17
State Project #MC0213000002

The Contractor shall secure any borrow source that is tested, approved, and cross-sectioned for excavation by means of physical control. The method of control shall be based on conditions at the source, but may consist of complete or partial fencing, earth berms, guardrails, or other physical barriers. A gate, chain, cable, or other acceptable device shall be installed across the entrance to the source and secured by padlock. The key to the padlock will be retained by the Department, once the security method is approved.

The Contractor shall submit a physical control plan to the Engineer after the borrow source has been tested and approved, and the overburden removed. The physical control plan must be implemented and approved before the source is cross-sectioned. After excavation is completed, all borrow areas shall be trimmed and left in a neat condition to permit accurate measurement. Where practicable, water shall not collect or stand therein.

209.06 Source Testing. The Department will assist the Contractor in determining the quality and quantity of material from sources it may propose to use. The Department will perform soil analysis tests on one test boring for each 500 yd³ (400 m³) of borrow.

209.07 Placing and Compacting. All borrow under this Section shall be placed and compacted in accordance with the requirements of Subsection 202.05. Placing of Type B hydraulic fill must be approved by the Engineer.

209.08 Utility Backfill. For utility trenches within the roadway, trenches shall be backfilled with material conforming to the requirements of Subsection 209.04, Borrow Type C. If the existing material meets these requirements, it shall be used for utility backfill. For these areas, backfill material shall be compacted to 95% or more of the maximum density according to the requirements of Subsection 202.05 (f). For utility trenches outside the roadway, trenches shall be backfilled with material conforming to the requirements of Subsection 209.04, Borrow Type C, to a height of 12" (300 mm) above the top of the utility, unless directed otherwise. The remaining depth of these utility trenches shall be backfilled with existing material, unless otherwise directed. For these areas, backfill material shall be compacted to 90% or more of the maximum density according to the requirements of Subsection 202.05 (f).

Material for backfilling utility trenches shall be furnished by the Contractor. Materials shall be stockpiled at location(s) mutually agreed upon by the Contractor, the utility, and the Engineer.

The operation of backfilling utility trenches shall be performed by the utility organizations involved and shall conform to the requirements of Subsection 202.05 (c) and (d), except proof rolling will not be required.

Utility companies will be required to remove all excess excavation material from the Project, unless the Engineer directs it to be utilized by the Contractor in the Project.

209.09 Method of Measurement. The quantity of borrow material will be measured in cubic yards (cubic meters) of approved and acceptable borrow material. The volume will be measured at the source, in its original position by cross-sections and computed by the method of average end areas, exclusive of the volume of overburden or stripping.

When requested by the Contractor and approved by the Department in writing, borrow material, which is specified to be measured in cubic yards (cubic meters), may alternatively be weighed and the weight converted to cubic yards (cubic meters). Factors for conversion from weight measurement to volumetric measurement will be determined by the Engineer and shall be agreed to by the Contractor, before the method is used.

**SECTION 210 - FURNISHING BORROW FOR PIPE TRENCH,
UTILITY TRENCH, AND STRUCTURE BACKFILLING**

210.01 Description. This work consists of furnishing borrow for use as backfill in pipe and utility trenches, and structure excavations.

210.02 Materials. Material shall conform to the requirements of Subsection 209.04.

210.03 Method of Measurement. The quantity of borrow will be measured in cubic yards (cubic meters) in accordance with the requirements of Subsection 209.09.

CANNOT BE USED FOR BIDDING

SECTION 212 - UNDERCUT EXCAVATION

212.01 Description. This work consists of excavation to correct unstable subgrades and embankment foundations and the disposal of such excavated material.

212.02 Materials. All material removed in the work of undercut excavation will be classified unsuitable and shall be disposed of, unless otherwise directed.

CONSTRUCTION METHODS.

212.03 Equipment. Equipment utilized in undercutting and backfilling operations shall be capable of removing and replacing the material within the area established by the Engineer. Equipment that will displace the underlying or adjacent material will not be permitted.

212.04 Preparation. When unstable subgrade or foundation conditions are encountered, all normal construction preparation procedures shall be performed to correct the unstable situation before undercutting will be considered. After performing these normal preparation procedures, the Contractor shall allow sufficient time to elapse to accurately judge the success of the preparation effort. These normal construction preparation procedures shall include, but are not limited to, cutting channels and ditches in order to lower the water table, grading to prevent excessive surface water from entering the subgrade or foundation materials, performing all reasonable efforts to correct the moisture content to within specifications, and using properly sized equipment in such a way that does not overload the subgrade or foundations. Interpretation of "normal", "sufficient", and "reasonable", shall be made by the Engineer.

In lieu of following the above established preparation requirements, or following the required construction methods, or waiting over a reasonable time for the environmental conditions to improve, the Contractor may elect to replace the subgrade or foundation material as a means of correcting instability.

212.05 Undercutting. When the Engineer determines that undercutting is required, the Engineer will direct the Contractor to remove the material from within defined areas to defined depths. Prior to backfilling, additional depths of undercutting below the original defined depth may be required in some areas as directed by the Engineer.

Upon acceptance of the undercut excavation, the area shall be backfilled and compacted in accordance with Section 202, or as directed. The Contractor shall conduct undercut operations in a manner that will allow the Engineer to take necessary measurements, before any backfill is placed. No backfill material shall be placed in water unless approved.

Any area remaining unstable after backfilling shall be reworked in accordance with this Section. When such rework is required, the Contractor shall salvage and reuse as much of the previously placed backfill as possible. If the Engineer determines that an unstable subgrade or embankment foundation exists, the unstable condition within the affected limits shall be satisfactorily corrected.

212.06 Performance Requirements. The correction of an unstable condition shall result in a firm, unyielding foundation.

SECTION 250 SEDIMENT REMOVAL

250.01 Description. This work consists of the excavation, hauling, and disposal of accumulated sediment from temporary sediment control items, such as sediment traps, sediment basins, silt fences, stone check dams, dewatering basins, dikes, swales, and diversions.

250.02 Construction Methods. Sediment shall be removed using any method of hand tools or mechanized equipment deemed appropriate by the Contractor and acceptable to the Engineer at each location or as required by the Contract documents.

SECTION 251 SILT FENCE

251.01 Description. This work consists of furnishing, constructing, maintaining, and ultimately removing, and installing silt filter fences or reinforced silt fences as a temporary measure to control sedimentation within the limits of construction. Silt fences shall be constructed as shown on Standard Construction Detail, Silt Fence, at the locations shown on the Plans, and as directed by the Engineer.

MATERIALS.

251.02 General. All materials shall be approved prior to use by the Department's Materials and Research Section.

251.03 Posts. Posts shall be constructed of oak timber or steel. Posts shall be a minimum of 42" (1050 mm) long and at least 18" (450 mm) longer than the height of the silt fence.

- (a) *Oak Timber Posts.* Oak timber posts shall be straight and have a minimum nominal cross-section of 2 by 2" (50 by 50 mm).
- (b) *Steel Posts.* Steel posts shall be 2½" (65 mm) diameter Schedule 40 pipe or be standard steel "T" or "U" section of 1.30 lb/ft (1.98 kg/m) minimum.

251.04 Fasteners. Fasteners shall be either 5/8" (16 mm) long brass or copper staples, or 17 gage (1.37 mm) galvanized or aluminized steel tie wires long enough to securely attach the fabric to the posts.

251.05 Wire Mesh. Wire mesh shall be galvanized welded wire reinforcement 6 by 6-W 1.4 by W 1.4 (152 by 152 - MW9 by MW9).

251.06 Seed. Seed shall conform to the requirements of Section 734.

251.07 Mulch. Mulch shall conform to the requirements of Section 735.

251.08 Geotextile. Geotextile shall conform to the requirements of Section 827. It shall be a minimum of 36" (900 mm) wide.

251.09 Prefabricated Silt Fence. The Contractor shall have an option to use prefabricated silt fence provided it has been constructed with the materials specified in this Section and approved by the Engineer.

CONSTRUCTION METHODS.

251.10 Construction of Silt Fence. The Contractor shall excavate the trench along the upstream side of the post line as shown on Standard Construction Detail, Silt Fence. Posts shall be installed on the downstream edge of the trench, along the established fence line.

The geotextile shall be fastened to the upstream side of the posts. The geotextile roll ends shall be overlapped a minimum of 6" (150 mm) at post locations.

The geotextile shall be embedded in the excavated trench. The trench shall be backfilled and compacted over the geotextile to prevent water from flowing under the geotextile.

The silt fence shall not be constructed across a ditch, or swale, or area of concentrated flow. On slopes, the terminal ends of silt fence shall be turned upslope a sufficient distance to eliminate flow around the ends of the silt fence.

All geotextile damaged prior to installation, during installation, or during the life of the Contract shall be repaired or replaced to the satisfaction of the Engineer.

92

251.11 Construction of Reinforced Silt Fence. The Contractor shall construct the reinforced silt fence according to Subsection 251.10. The wire mesh shall be fastened to the posts so that the wire mesh is between the geotextile and the posts. The geotextile shall be fastened to the wire mesh at the required spacing.

251.12 Maintenance of Silt Fence. Throughout the Project construction period, the silt fence shall be maintained by removing trapped sediment. The Contractor shall clean the geotextile of trapped sediment by tapping the geotextile when dry. No trash shall be allowed to accumulate to the height of the fence. Any geotextile that does not function due to clogging or deterioration shall be replaced.

251.13 Sediment Removal. After every heavy rainfall, the Contractor shall check for excessive buildups of sediment which must be removed so that the silt fence can continue to function as intended. Accumulated sediment shall be removed by the Contractor when it reaches 50% of the height of the silt fence.

251.14 Removal of Silt Fence. The silt fence shall be removed when the Engineer determines that it is no longer required. The silt fence and all materials incidental to the silt fence construction shall be removed. All areas affected by the construction of the silt fence shall be restored to the original or plan contours and stabilized with seed and mulch.

SECTION 252 INLET SEDIMENT CONTROL

252.01 Description. This work consists of furnishing, constructing, maintaining, and ultimately removing sediment control around drainage inlets and curb inlets as a temporary measure to control sedimentation within the limits of construction. Inlet sediment control shall be constructed as shown on Standard Construction Details, Drainage Inlet Sediment Control and Curb Inlet Sediment Control, at the locations shown on the Plans, and as directed by the Engineer.

MATERIALS.

252.02 Lumber. Lumber shall be construction grade two-by-four measuring 1½ x 3½" (38 by 89 mm) and free from warps, checks, splits, and decay.

252.03 Wire Mesh. Wire mesh shall be steel or galvanized welded wire reinforcement with openings ½ x ½" (13 by 13 mm) and wire diameter of 19 gage (1.04 mm).

252.04 Seed. Seed shall conform to the requirements of Section 734.

252.05 Mulch. Mulch shall conform to the requirements of Section 735.

252.06 Stone. Stone shall be Delaware No. 3 conforming to the requirements of Section 813.

252.07 Geotextile. Geotextile shall conform to the requirements of Section 827.

252.08 Prefabricated Sediment Control. The Contractor shall have an option to use prefabricated sediment control devices provided each has been constructed with the materials specified in this Section and approved by the Engineer. Approval will be based on satisfactory performance at field test locations chosen by the Engineer.

CONSTRUCTION METHODS.

252.09 Construction of Drainage Inlet Sediment Control. The Contractor shall excavate completely around the walls of the inlet to the required depth. The corner posts shall be driven to the required depth below the excavated depth. The two-by-four frame shall be assembled and completed using overlapped joints. The lumber frame shall be set at a top elevation that ensures that water ponded by the inlet sediment control will not create a flooding or safety hazard.

Wire mesh shall be stretched tightly around the lumber frame and fastened securely. The geotextile shall be stretched tightly over the wire mesh and shall be fastened securely to the lumber frame at the required depth. The ends of the geotextile must meet at the posts, be overlapped and folded, and then fastened to the posts. After the geotextile is fastened to the posts, the Contractor shall backfill the previously excavated trench according to Subsection 207.05.

If the inlet is not in a low point, the Contractor shall construct a sediment control earth dike in the ditch line, downstream from the inlet, as shown on Standard Construction Detail, Drainage Inlet Sediment Control. The earth dike shall conform to the requirements of Section 260.

252.10 Construction of Curb Inlet Sediment Control. The Contractor shall assemble the two-by-four weir frame using overlapped joints. The weir frame shall be securely nailed to the vertical spacers as shown on Standard Construction Detail, Curb Inlet Sediment Control.

The Contractor shall place the assembly over the grate and against the inlet throat making sure that the end vertical spacers are at least 12" (300 mm) beyond each end of the throat opening and the grate. The two-by-four anchors shall be nailed to the top of the frame at the spacer locations. The anchors shall extend across the curb and be held in place by sandbags or alternate weights.

The Contractor shall lay a continuous piece of wire mesh over the grate, against the weir frame, and extending at least 12" (300 mm) from both ends of the weir frame. The wire mesh shall be formed to the concrete gutter and against the face of the curb at both ends of the inlet.

The Contractor shall place a piece of geotextile, of the same dimension as the wire mesh, over the wire mesh and securely attach it to the weir frame. The geotextile shall be formed to the wire mesh at both sides of the inlet. Clean stone shall be placed over the geotextile and the wire mesh to prevent water from entering the inlet from under or around the geotextile.

252.11 Maintenance of Inlet Sediment Control. Throughout the Project construction period, the inlet sediment controls shall be maintained and remain functional. Maintenance shall include cleaning the geotextile of trapped sediment by tapping the geotextile when it is dry. After every rainfall, the Contractor shall inspect the inlet sediment control. The geotextile and, if applicable, the stones shall be replaced when 50% of the voids are clogged. Any geotextile that does not function due to clogging or deterioration shall be replaced.

252.12 Sediment Removal. The Contractor shall remove all accumulated sediment from around the drainage inlet sediment control when the sediment has reached 6" (150 mm) from the top of the geotextile. When the sediment has reached 50% of the height of the curb, the Contractor shall remove all accumulated sediment from around the curb inlet sediment control.

252.15 Basis of Payment. The quantity of drainage inlet sediment controls will be paid for at the Contract unit price for each. The quantity of curb inlet sediment controls will be paid for at the Contract unit price for each. Price and payment will constitute full compensation for furnishing and installing all required materials, including lumber, wire mesh, geotextile, and stone; for excavating and backfilling; for maintaining the inlet sediment controls, including replacing the geotextile and stone; for removing the sediment controls and all incidental materials; for restoring the site; for seeding and mulching; and for all labor, tools, equipment, and incidentals required to complete the work.

The quantity of sediment removal will be paid for according to Section 250.

SECTION 254 STONE CHECK DAM

254.01 Description. This work consists of constructing, maintaining, and ultimately removing small stone check dams across a swale, channel, or any type of ditch as a temporary measure to reduce the velocity of concentrated flows, thereby reducing erosion of the swale, channel, or ditch. Stone check dams shall be constructed as shown on Standard Construction Detail, Stone Check Dam, at the locations shown on the Plans, and as directed by the Engineer.

MATERIALS.

254.02 Riprap. Riprap shall be R-4 conforming to the requirements of Section 712 with the exception that geotextile will not be required to be placed under the riprap.

254.03 Seed. Seed shall conform to the requirements of Section 734.

254.04 Mulch. Mulch shall conform to the requirements of Section 735.

CONSTRUCTION METHODS.

254.05 Construction of Stone Check Dam. The stone check dam shall be constructed in reasonably straight sections of the swale or channel. The Contractor shall place the riprap so that it completely covers the width of the channel. The top of the stone check dam shall be constructed so that the center is lower than the outer edges, forming a spillway across which the water can flow as shown on Standard Construction Detail, Stone Check Dam.

254.06 Maintenance of Stone Check Dam. After each rainfall, the Contractor shall inspect the stone check dam for sediment accumulation or washout. The Contractor shall replace the riprap whenever washout, construction traffic damage, or silt accumulation among the riprap occurs and whenever the stone check dam ceases to function as intended.

254.07 Sediment Removal. Sediment shall be removed from behind the check dams when it has accumulated to one-half of the original height of the stone check dam at the spillway.

254.08 Removal of Stone Check Dam. Temporary stone check dams shall be removed only when directed by the Engineer. If stone check dams are used in grass-lined swales or channels which are mowed, the Contractor shall ensure that all riprap is removed when the stone check dam is removed. In temporary swales and channels, check dams should be removed and the ditch filled in when it is no longer needed. In permanent swales or channels, check dams may be removed when a permanent non-erodible lining can be installed. In the case of grass-lined ditches, check dams may be removed when the grass has matured sufficiently to protect the swale or channel. The area beneath the check dams should be seeded and mulched immediately after the check dams are removed.

SECTION 257 - RIPRAP DITCH

257.01 Description. This work consists of constructing and maintaining trapezoidal riprap ditches with supporting toe walls to convey concentrated flow without damage from erosion and where grassed ditches would be inadequate due to a high flow velocity. Riprap ditches shall be constructed as shown on Standard Construction Detail, Riprap Ditch, at the locations shown on the Plans, and as directed by the Engineer.

MATERIALS.

257.02 Pins. Pins shall be steel, 18" (450 mm) long, 3/16" (4.7 mm) in diameter, and have a head or steel washer that is 1½" (38 mm) in diameter.

257.03 Riprap. Riprap shall be the type indicated on the Plans and shall conform to the requirements of Section 712.

257.04 Seed. Seed shall conform to the requirements of Section 734.

257.05 Mulch. Mulch shall conform to the requirements of Section 735.

257.06 Stone. Stone for bedding shall be Delaware No. 57 conforming to the requirements of Section 813.

257.07 Geotextile. Geotextile shall conform to the requirements of Section 827.

CONSTRUCTION METHODS.

257.08 Construction of Riprap Ditch. The Contractor shall excavate the riprap ditch according to the dimensions shown on the Plans. All debris shall be removed from the ditch. The ditch sides and bottom shall be smooth so that the geotextile rests flush with the ditch at all points of contact. The width of the geotextile shall be sufficient to cover the total width of the ditch and completely line the toe walls without any longitudinal joints. The geotextile shall be placed flat, loose, and without wrinkles against all surfaces. The geotextile shall be secured in place with pins as shown on the Standard Construction Details.

After placement of the geotextile and pins on the ditch banks, stone bedding, if required, and riprap in the ditch, the Contractor shall backfill, grade, compact, and restore the ditch banks and any other area affected by the construction of the riprap ditch to the original or plan contours. The restored areas shall be stabilized with seed and mulch.

The Contractor shall not perform any grading of the ditch after placement of the riprap.

257.09 Maintenance of Riprap Ditch. Throughout the Project construction period, the Contractor shall maintain the original dimensions and function of the riprap ditch.

SECTION 264 - DEWATERING BASIN

264.01 Description. This work consists of constructing, maintaining, and ultimately removing dewatering basins as shown on Standard Construction Detail, Dewatering Basin, at the locations shown on the Plans, and as directed by the Engineer.

MATERIALS.

264.02 Borrow. Borrow for fill material for the berm shall be clean mineral soil free of roots, woody vegetation, stones greater than 4" (100 mm) in diameter, or other objectionable materials. Sandy or gravelly soils classified as GW, GP, SW, and SP under the Unified Soil Classification System shall not be used in the embankment.

264.03 Geotextile. Geotextile shall conform to the requirements of Section 827.

264.04 Riprap. Riprap shall be R-4 conforming to the requirements of Section 712.

264.05 Seed. Seed shall conform to the requirements of Section 734.

264.06 Mulch. Mulch shall conform to the requirements of Section 735.

CONSTRUCTION METHODS.

264.07 Construction of the Dewatering Basin. The area under the berm shall be cleared, grubbed, and stripped of topsoil. In order to facilitate clean out and restoration, the pool area will be cleared of all brush, trees, and other objectionable materials.

The fill material for the berm and the area on which the fill material for the berm is to be placed shall have sufficient moisture so that it can be formed by hand into a ball without crumbling. If water can be squeezed out of the ball, it is too wet for proper compaction. The fill material shall be placed in 12" (300 mm) thick lifts over the entire length of the fill. Compaction shall be obtained by tamping the berm with the flat side of the backhoe bucket used to excavate the dewatering basin.

264.08 Vegetative Treatment. The berm top and side slopes shall be stabilized immediately after construction with seed and mulch.

264.09 Maintenance of the Dewatering Basin. Throughout the Project construction period, the Contractor shall maintain the dewatering basin to its original dimensions and function.

264.10 Sediment Removal. The Contractor shall remove all accumulated sediment when the basin is filled to one-half of its original basin.

264.11 Removal of Dewatering Basin. The dewatering basin shall be removed at the end of the construction period or when directed by the Engineer. The dewatering basin and all materials incidental to its construction shall be removed. All areas affected by the construction, use, and removal of the dewatering basin shall be restored to the original or plan contours and stabilized with seed and mulch.

SECTION 271 - STORMWATER MANAGEMENT POND

271.01 Description. This work consists of constructing the foundation, dam, reservoir, and emergency spillway for a stormwater management pond at the location shown on the Plans and as directed by the Engineer.

271.02 Materials. Borrow for stormwater management pond construction shall conform to the requirements of Subsection 274.02. The types of soil required are as follows:

- Foundation Cutoff.....Clay Borrow, Type 1
- Dam.....Clay Borrow, Type 2

CONSTRUCTION METHODS.

271.03 Excavation. The Contractor shall excavate for the stormwater management pond in reasonably close conformity with the lines and grades shown on the Plans or as directed by the Engineer. All suitable material removed as excavation shall be used in constructing the dam foundation and embankment before securing or hauling any borrow, or unless directed by the Engineer. Materials determined by the Engineer to be unsuitable for use in the dam foundation and embankment shall be deposited on slopes as directed by the Engineer or removed from the Project site and disposed.

If rock excavation, as defined in Section 205, is necessary for construction of the stormwater management pond, it shall be paid for in accordance with Section 205. The classification "Rock Excavation" shall not apply to soft disintegrated rock. This material is classified as normal excavation and is included in Section 271.

SECTION 272 - POND OUTLET STRUCTURE, CONCRETE

272.01 Description. This work consists of furnishing, fabricating, and constructing a pond outlet structure at the locations shown on the Plans and as directed by the Engineer.

MATERIALS.

272.02 Borrow. Borrow for backfill material shall be Clay Borrow, Type 2 and shall conform to the requirements of Subsection 274.02.

272.03 Concrete. Concrete used in risers may be precast or cast-in-place. Concrete used in anti-seep collars shall be cast-in-place only. Concrete used in risers and anti-seep collars shall be Class A conforming to the requirements of Section 812

272.04 Reinforcing Steel. Reinforcing steel shall be Grade 60 (Grade 400) and conform to the requirements of Section 603.

272.05 Grout. Grout shall be non-shrink conforming to the requirements of ASTM C 1107.

272.06 Pipe. Reinforced concrete pipe used for the principal spillway shall conform to Section 612.

272.07 Gaskets. Gaskets for reinforced concrete pipe shall conform to Subsection 612.03.

272.08 Steps. Steps shall be molded plastic with a reinforcing bar core, and shall conform to the requirements of AASHTO M 31/M 31M, ASTM A 478, and ASTM D 4101.

CONSTRUCTION METHODS.

272.09 Excavation. The Contractor shall excavate to the required depth. The foundation upon which the structure is to be placed shall be compacted to a firm and level surface.

272.10 Outlet Structure.

- (a) *Riser.* Concrete risers shall be poured in place or pre-cast. If the concrete risers are pre-cast, the Contractor shall design the lifting lugs, and all hardware required to transport and install the structure. The top slab shall not be used to lift the riser structure. Any space between pipes and the walls of the pre-cast riser shall be filled with grout.
 - A) The largest dimension of the opening in the riser of connection of the outfall pipe shall be no greater than the outfall pipe diameter plus 4" (100 mm).
- (b) *Anti-Seep Collars.* The subgrade soil shall be excavated to the dimensions of the bottom half of the collars. Concrete forming the bottom half of the anti-seep collars shall be poured into the excavation using the adjacent soil as the form. Concrete formwork shall be used to form the top half of the anti-seep collars.

- (c) *Principal Spillway Outfall Pipe.* The principal spillway pipe shall have Class A pipe bedding. Shims used to establish grade and alignment of the pipe shall be made of concrete. Lumber or bricks shall not be used for shims. Care shall be exercised during backfill to prevent any pipe movement from its horizontal and vertical alignment.

When the principal spillway outfall pipe is to be placed partially or completely in fill, the fill embankment shall be constructed 24" (600 mm) above the proposed top of pipe. A trench shall then be excavated to the required grade with side slopes no steeper than 1:1.

The Contractor shall place bell and spigot pipes with the bell end upstream. The pipe trench shall be kept free of standing water during pipe placement and backfilling using an approved dewatering method.

272.11 Backfill. The backfill material next to pipes and other structures shall be placed to the required elevation in 4" (100 mm) horizontal loose-thickness lifts at the same rate on all sides to prevent damage from unequal loading. Each lift shall be compacted by a manually directed power tamper under and around the pipe and other structures to 90% or more of maximum dry density. Compaction next to cast-in-place concrete structures will not begin until the concrete has reached enough strength to support the load.

A minimum depth of 24" (600 mm) of hand compacted backfill shall be placed over the pipe before crossing it with construction equipment.

DIVISION 300 – BASES

SECTION 301 SELECT BORROW BASE COURSE

301.01 Description. This work consists of furnishing, placing, and compacting select borrow material on a prepared subgrade.

301.02 Materials. The material used for the select borrow base course shall conform to the requirements of Subsection 209.04, Borrow Type G.

Source of material for the select borrow base course shall conform to the requirements of Subsection 209.05.

Source testing shall conform to the requirements of Subsection 209.06.

CONSTRUCTION METHODS.

301.03 Equipment. The Contractor shall provide equipment of the proper type and weight to do the grading, leveling, and compacting work as specified. Compaction shall be uniformly attained by approved rollers or compactors.

301.04 Preparation of Subgrade. The subgrade shall be properly shaped. It shall also be uniformly and thoroughly compacted in conformance with the lines and grades as shown on the Plans or as established by the Engineer, before any base course material is placed. These operations shall be performed in accordance with Subsection 202.06.

The subgrade shall be maintained as established in Subsection 202.06. Test rolling shall be performed as established in Subsection 202.02.

No base course material shall be placed until the subgrade has been approved by the Engineer.

301.05 Placement of Select Borrow Base Course. Select borrow base course material shall be placed in successive layers. Each layer shall be placed in a level, uniform cross-section not to exceed 8" (200 mm) in depth, loose measurement, unless otherwise approved by the Engineer. The material shall be deposited and promptly spread parallel to the centerline. Each layer shall extend the full plan width.

If a layer does not contain a uniform distribution of moisture and component materials, it shall be disced or processed in a manner to ensure homogeneity. Each layer shall be properly compacted, as specified, before starting the next layer.

Compaction or rolling shall start at the edges and progress toward the center and shall continue until each layer is thoroughly and uniformly compacted to the full width.

In no case shall vehicles be allowed to travel in a single track or form ruts in the base course. If any sharp irregularities are formed, the base course shall be scarified to a depth of 6" (150 mm) and recompacted.

301.06 Performance Requirements. Compaction shall continue until each layer is thoroughly and uniformly compacted to 100% or more of the laboratory maximum density on representative material.

The moisture content of the select borrow base course material at the time of compaction shall be within 2% of the optimum. The material shall either be moistened or dried, as needed, and thoroughly mixed before compaction.

Field compaction shall comply with the requirements of the following AASHTO test methods as modified by the Department:

- (a) AASHTO T 99 Method C, Moisture-Density Relationship.
- (b) AASHTO T 191, Density By Sand Cone.
- (c) AASHTO T 224, Coarse Particle Correction.
- (d) AASHTO T 238, Density By Nuclear Methods.
- (e) AASHTO T 239, Moisture Content by Nuclear Methods.
- (f) AASHTO T 272 Method C, Moisture-Density Family of Curves.

The finished surface of the select borrow base course shall not vary from that required on the Plans by more than ½" (13 mm) when tested with a 10' (3.048 m) straightedge applied to the surface parallel to the centerline of the pavement, and when tested with a template cut to the cross-section of the pavement.

A straightedge meeting the approval of the Engineer shall be supplied by the Contractor at each placement operation. The straightedge shall be constructed of rigid materials that resist warping and bending.

SECTION 302 - GRADED AGGREGATE BASE COURSE

302.01 Description. This work consists of furnishing, placing, and compacting graded aggregate base course materials on a prepared subgrade or base.

302.02 Materials. The material used to construct graded aggregate base course shall conform to the requirements of Section 813 and Section 821, Type B.

CONSTRUCTION METHODS.

302.03 Subgrade Preparation. The subgrade shall be properly constructed in accordance with Subsection 202.06.

No base course material shall be placed until the subgrade has been approved by the Engineer.

302.04 Placement.

(a) *Equipment.* The aggregate materials shall be spread uniformly by an approved spreading machine or box in such a manner that no segregation occurs. A conventional motor grader will not be approved for placement of graded aggregate on mainline roadway sections.

Where it is not possible to use a spreading machine or box in patching or other tight areas, other approved methods can be used only in such manner that no segregation occurs. Water shall be uniformly applied with an approved sprinkling device. Compaction shall be uniformly attained by approved rollers or compactors. No graded aggregate shall be placed until approved equipment is on the Project site and is operational.

(b) *Spreading and Compacting.* Graded aggregate material conforming to the requirements of Section 821 shall be placed in successive layers. Each layer shall be placed in a level, uniform cross-section not to exceed 8" (200 mm) in depth, loose measurement, unless otherwise approved by the Engineer. The material shall be deposited and spread parallel to the centerline, and the layer shall extend to the full width as shown on the Plans. The material shall be handled so that no segregation of fine or coarse particles occurs. No more than 1,0002 (300 m) of material, as measured along the roadway centerline, shall be spread in advance of compaction operations.

Each layer shall be properly compacted as specified, before starting the next layer. Water shall be added before the material is compacted. The water shall be applied in a manner that results in a uniform and adequate moisture content.

Compaction or rolling shall be performed parallel to the roadway centerline starting at the edges and progressing toward the center. It shall continue until each layer is thoroughly and uniformly compacted to the full width as shown on the Plans.

After compacting, all voids in the surface of each layer shall be filled with aggregate meeting the requirements of Section 813, Delaware No. 10. Water shall be applied to the surface and compaction continued. Additional Delaware No. 10 aggregate placement, water application, and compaction shall continue until the layer of base material is well bonded and firm, as determined by the Engineer.

In no case shall vehicles be allowed to travel in a single track or to form ruts in the base course. If any sharp irregularities are formed in the subgrade or base course material, the affected area shall be scarified to a depth of 6" (150 mm) and compacted to conform to the requirements of Section 202 or this Section.

- (c) *Performance.* The moisture content of the base course material at the time of compaction shall be within 2% of the optimum moisture content. If the moisture content is not within 2% of optimum, the material shall either be moistened or dried, as needed, and thoroughly mixed before compaction.

Compaction of graded aggregate Type A shall continue until each layer is thoroughly and uniformly compacted into a firm and unyielding surface, to the satisfaction of the Engineer. Compaction of graded aggregate Type B shall continue until each layer is thoroughly and uniformly compacted to 98% or more of the laboratory maximum density obtained on a sample of the same material. If the material is too coarse to use the test methods listed below, compaction shall continue until there is no movement of the material under the compaction equipment.

The determination of compliance with performance requirements as specified in this Subsection shall be in accordance with the following test methods, as modified by the Department:

- (1) AASHTO T 99 Method C, Moisture-Density Relationship.
- (2) AASHTO T 191, Density By Sand Cone.
- (3) AASHTO T 224, Coarse Particle Correction.
- (4) AASHTO T 238, Density By Nuclear Methods.
- (5) AASHTO T 239, Moisture Content By Nuclear Methods.
- (6) AASHTO T 272 Method C, Moisture-Density Family Of Curves.

The finished surface of the graded aggregate base course shall not vary from that required on the Plans by more than 1/2" (13 mm) when tested with a 102 (3.048 m) straightedge applied to the surface parallel to the centerline of the pavement and when tested with a template cut to the cross-section of the pavement. The actual thickness of the graded aggregate base course shall not be more than 1/2" (13 mm) less than the thickness shown on the Plans; however, the actual thickness may be greater than that shown on the Plans. Those portions of completed graded aggregate base course not meeting these performance requirements shall be completely removed and replaced with proper material placed in accordance with this Section.

A straightedge meeting the approval of the Engineer shall be supplied by the Contractor at each placement operation. The straightedge shall be constructed of rigid materials that resist warping and bending.

SECTION 304 - ASPHALT STABILIZED BASE COURSE

304.01 Description. This work consists of scarifying, stabilizing with asphalt, compacting, and shaping the base course.

304.02 Materials.

- (a) *Asphalt.* Asphalt for stabilization shall be a high-float, medium-setting emulsion conforming to the requirements of Section 809. Other types of mixing grade emulsions may be submitted for laboratory evaluation and approval.

Prior to approval of any emulsion type or source of supply, the Contractor shall submit to the Department's Materials and Research Section a 1 gal (4 L) emulsion sample for laboratory analysis and mixing evaluation. A laboratory analysis report prepared by the supplier shall accompany the sample.

Laboratory evaluation shall include a determination of mixing qualities of the emulsion and water with silicious sandy soils representative of the soil types found within the Project location and conforming to Subsection 209.04, Borrow Type E. Fast breaking emulsion yielding globules of unmixed asphalt or emulsions which fail to thoroughly and homogeneously blend throughout the emulsion-water-soil mixture will be judged unsatisfactory for use. The moisture content of the soil-emulsion mixed in the laboratory shall range from 5 to 9% with optimum moisture and maximum density determined in accordance with AASHTO T 180 Method A, Modified. Molded soil-emulsion specimens will also be evaluated by air curing, water immersion, absorption, and compression testing.

All testing will be performed at the Department's Materials and Research Laboratory. Upon completion of all laboratory testing and review of the data, the decision of the Department as to emulsion acceptability will be final. Approval of the material will also be contingent on satisfactory performance under field mixing conditions.

- (b) *Water.* Water to be used in the stabilizing process shall conform to the requirements of Section 803.
- (c) *Soils.* All materials to be stabilized shall consist of local soils or borrow soils or a mixture of both. These materials shall be free from roots and leaves and any other types of organic matter. Local soils to be stabilized shall be granular in nature and approved prior to use. All borrow shall conform to the requirements of Subsection 209.04, Borrow Type E.

304.03 Equipment. The type, condition, and quantity of equipment furnished shall meet the qualifications necessary for the proper execution of the work within the specified working time. Equipment shall bear the manufacturer's name plate, on which shall be stamped the model number. All equipment shall be maintained in good condition and be subject to approval prior to and during its use in connection with the Project. Compaction equipment shall also conform to the requirements of Subsection 202.05 (d).

304.04 Construction Methods. Before any stabilization is started, the roadway shall be widened and graded. Ditches and slopes shall be cut, borrow shall be placed, and the entire section shall be formed in accordance with the typical sections shown on the Plans. Where applicable, the requirements of Section 202 shall apply.

After the prepared roadway has been approved and prior to the addition of asphalt, the base course shall be scarified to the full depth that will give, when mixed with asphalt, a compacted base having a thickness as shown on the Plans and within the specified tolerances. The scarified base course shall then be mixed, and water shall be added or aeration shall take place until the moisture content of the soil to be stabilized is between 90 and 110% of the optimum mixing moisture as determined by the Department. Mixing shall continue until clay lumps and other cohesive materials present are broken up and distributed evenly. The mixing operation shall be considered complete when the moisture content of the material to be stabilized is uniform and between 90 and 110% of the optimum mixing moisture and the soil lumps have been pulverized.

After the base course has been mixed as described in this Subsection, asphalt shall be applied at a temperature between 140 and 170 °F (60 and 77 °C). The quantity of asphalt shall range from 14 to 20 gal/yd³ (70 to 100 L/m³) of compacted thickness of base shown on the Plans, depending on the properties of the soil. The number of gallons per cubic yard (liters per cubic meter) to be applied will be determined by the Department.

No asphalt shall be applied unless the mixing operation can be completed within two and one-half daylight hours following the application of the asphalt. Asphalt shall not be applied to a new section on any succeeding day until those portions which have been mixed previously are aerated and compacted to the specified requirements. If field conditions render the requirements of the preceding sentence impracticable, such as inclement weather, then the Engineer will have the option of waiving the requirements.

Immediately following the application of asphalt, the base course shall be thoroughly mixed with self-propelled mixers. There must be at least two self-propelled mixers of the multiple pass type or one of the single pass type used in this phase of the stabilization operation. During the mixing operation, care shall be taken to avoid cutting below the prepared soil layer and incorporating additional raw soil into the mix. The mixing operation shall be considered complete when the asphalt and soil have been thoroughly mixed to a uniform color free from fat spots, streaks, balls, and uncoated particles throughout the full length, width, and depth of the section.

Following the mixing of the asphalt and soil, a period of aeration shall take place until the moisture content of the mixture is between 75 and 100% of the optimum moisture content as determined by AASHTO T 180 Method A, Modified. Compaction shall then begin, starting at the edges and progressing toward the center of the base course. This compaction shall continue until the base course is shaped and rolled until approved. The thickness of the stabilized base and the surface of the base course will then be tested and shall conform to the tolerances as specified:

- (a) *Thickness.* The thickness of the soil asphalt mixture shall be within ½" (13 mm) of the plan thickness and shall be determined from the average of a set of measurements taken through holes made through the finished soil asphalt mixture at intervals not to exceed 500' (150 m) per lane. A set of measurements consists of three holes spaced 5' (1.5 m) apart in a triangular pattern with the thickness measured to the nearest ¼" (6 mm). Measurements will be made immediately following the finishing operation. If the average thickness shown by a set of measurements is not within the tolerances specified, additional sets of measurements shall be made at 25' (7.5 m) intervals forward and backward until at least two consecutive sets of measurements in each direction are within the tolerance specified. Areas represented by averages exceeding the tolerances specified may be required to be reconstructed.
- (b) *Surface.* The surface smoothness of the asphalt stabilized base course mixture during and after the compaction and finishing operations shall be tested with a 10' (3.048 m)

straightedge furnished by the Contractor. The straightedge shall be laid parallel to the centerline. Any irregularities greater than $\pm\frac{1}{2}$ " (± 13 mm) shall be satisfactorily corrected.

The base course shall then be opened to traffic, before sealing, for a period of time necessary to cure the stabilized mixture. This curing period shall not be more than 14 days unless otherwise approved. The stabilized base course shall be considered satisfactory for surfacing when the stabilized mixture has attained the following:

- (a) a minimum density of 120 lb/ft³ (1925 kg/m³) or a minimum of 95% of the maximum dry density as determined by AASHTO T 180 Method A, Modified;
- (b) a moisture content that does not exceed 65% of the optimum moisture content as determined by AASHTO T 180 Method A, Modified; and
- (c) base course that is properly shaped and has no soft, wet, or unstable areas.

No stabilization shall start on any project or portion thereof before April 1 of each year. All stabilization shall stop by September 30 of each year.

DIVISION 400 - BITUMINOUS PAVEMENTS
SECTION 400 - HOT-MIX, HOT-LAID BITUMINOUS CONCRETE PAVEMENT

401.01 Description. This work consists of constructing hot-mix, hot-laid bituminous concrete bases and surface courses on either a prepared foundation or an existing surface course.

401.02 Materials. Materials for hot-mix, hot-laid bituminous concrete shall conform to Section 823. Tack coat shall conform to Section 811. Sand for protection of traffic shall conform to Section 804.

401.03 Delivery of Mixture. The mixture shall be delivered at the spreader with a temperature loss not greater than 20 °F (11 °C) from the temperature measured at the plant by the Engineer's representative.

A minimum of 100 tons (90 metric tons) of hot-mix bituminous concrete per hour shall be delivered to the Project site unless otherwise directed.

EQUIPMENT.

401.04 Hauling Equipment. Trucks used for hauling bituminous concrete shall have tight, clean, smooth metal beds which have been thinly coated with an emulsified oil, soap solution, or other approved release agent to prevent adherence of the bituminous mixture to the bed of the truck. Each truck shall have a securely fastened cover of canvas or other suitable waterproof material that covers the bed from front to back and over the sides. The front of the tarp shall be securely fastened to the body or protected by an air foil. The cover shall have at least three straps to a side and two straps on the back to prevent the cover from ballooning up, to protect the mixture from the weather, and to prevent heat loss. In addition, from September 30 through March 31, the truck bed shall be insulated on the front, sides, and back with plywood or other suitable material. Trucks with heated bodies may be used if the heat is uniformly distributed along the entire area of both side walls. The front and back, unless they are uniformly heated along the entire area, shall be insulated with plywood or other suitable material. All covers used and trucks with heated bodies are subject to the approval of the Engineer. No loads shall be sent out so late in the day that spreading and compacting of the mixture cannot be completed by sunset unless approval for nighttime paving has been granted by the Engineer.

401.05 Pavers. Bituminous pavers shall be self-contained units, provided with an activated screed or strike-off assembly, heated, and capable of spreading and finishing asphaltic concrete in lane widths of the specified typical section and thickness shown on the Plans.

The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The front of the screed or strike-off assembly shall be equipped with an automatic control device that produces a finished surface of the required evenness and texture without segregation, tearing, shoving, or gouging the mixture. The paver shall be capable of operation at forward speeds consistent with satisfactory laying of the mixture. Stop and go operations of the paver shall be avoided. Equipment used for shoulders and similar construction shall be capable of spreading and finishing the courses in widths shown on the Plans.

The screed of the paver shall be regulated by an automatically controlled grade leveling and slope control device. The device shall be adapted to the type of paver used, and shall provide control for producing a uniform surface to the established grade and a cross slope conforming to the requirements

of the typical section. The device shall also be equipped with the necessary controls to permit the operator to adjust or vary the slope throughout superelevated curves. Grade control shall be accomplished using a sensor following a traveling reference plane not less than 302 (9 m) in length. If deemed necessary by the Engineer, a joint matching shoe referencing to an adjacent mat shall be used.

If the automatic controls fail or malfunction, the equipment may be operated manually for the remainder of the normal working day, provided specified results are obtained. Manual operation will be permitted for constructing irregularly shaped and other areas as approved by the Engineer. If the Contractor fails to obtain and maintain the specified surface tolerance, the paving operation shall be suspended until satisfactory corrections, repair, or equipment replacements are made.

401.06 Rollers. Rollers shall be self propelled, static or vibratory steel wheel type or a combination thereof, or the pneumatic-tire type. All rollers shall be capable of reversing without backlash, and shall be operated according to manufacturer's recommendations. Steel wheel rollers shall be equipped with scrapers. Pneumatic-tire rollers shall be of the oscillating type, equipped with smooth tires of equal size, diameter, and ply rating, all maintained at the same inflation pressure. Rollers shall have a system for moistening each wheel or roller. The number and weight of the rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Using equipment which results in excessive crushing of the aggregate or marring of the pavement surface will not be permitted.

All rollers shall be approved prior to use. The rollers shall be maintained in a satisfactory working condition, and shall bear the manufacturer's name plate stamped with the model number and the weight without ballast.

CONSTRUCTION METHODS.

401.07 Application of Tack Coat. A tack coat diluted with 50% water shall be applied on all dry and broom cleaned portland cement concrete and bituminous pavement surfaces. Tack coat shall be applied at a rate of 0.05 to 0.15 gal/yd² (0.23 to 0.68 L/m²), at a temperature of 70 to 160 °F (21 to 71 °C). The application rate appropriate for the surface being overlaid shall have prior approval of the Engineer. The tack coat should be a thin, uniform coating sufficient to bond the overlay to the underlying pavement. Tack coat shall be applied using pressurized distributing equipment with a spray bar or other approved distribution system. Tack coat shall be applied in advance of the hot-mix operation, but no further than is anticipated for the current day's hot-mix operation.

All contact surfaces of curbing, gutters, manholes, and other facilities shall be coated with a uniform coat of hot asphalt cement (tack) or other approved bituminous material just before the mixture is placed.

401.08 Placing Bituminous Mixtures. Prior to the delivery of the mixtures on the job, the underlying course shall have been brought to line, grade, and cross-section, and all excess patching material, joint material, dirt, and foreign material shall be removed. The mixtures shall be placed only upon a surface that is dry, and only when weather conditions are suitable.

Upon arrival, the mixture shall be dumped into the approved mechanical spreader, and immediately spread and struck off in a uniform layer to the full width required. The placed mixture shall be of such depth that when the work is completed, it will have the thickness shown on the Plans or as specified in the Contract and will conform to the grade and surface contour required. Machine methods of spreading and screeding are required unless otherwise permitted.

Should unevenness of texture, tearing, or shoving occur during the paving operation due to unsatisfactory material, methods, or equipment, the Contractor shall immediately take action to correct

JP COURTS 3/17

State Project #MC0213000002

401 HOT-MIX, HOT-LAID BITUMINOUS CONCRETE PAVEMENT

such unsatisfactory work.

The outside edges of the pavement shall be in true alignment, parallel to the centerline of the roadway. On Contracts requiring multiple lifts or courses, the width of the individual lifts shall be arranged such that the longitudinal joints of each successive lift are offset from the previous lift approximately 6" (150 mm). The longitudinal joint in the surface course shall be at the lane line.

The placement of roadway bituminous concrete shall be as continuous as possible. Intersections and irregular areas shall be paved after the adjacent roadway has been paved. Hand spreading with lutes will be permitted where irregularities or obstacles make the use of pavers impractical. The use of garden rakes will not be permitted.

No bituminous concrete shall be placed when the ambient air temperature at the location of the paving operation is below the temperatures indicated for the various types of bituminous concrete mixtures in the following table:

Table 401-A
Minimum Ambient Air Temperature for Placement of Types of Bituminous Material

Material Type	1" (25mm) Lift Or Less	1 to 2" (26 mm to 50 mm) Lift	Greater than 2" (50 mm) Lift
A	65° F (18° C)	N/A	N/A
B	50° F (10° C)	40° F (4° C)	32° F (0° C)
C	50° F (10° C)	40° F (4° C)	N/A
D	50° F (10° C)	40° F (4° C)	N/A
E	N/A	N/A	32° F (0° C)

Note: Type A - Open graded plant mix wearing surface
 Type B - Dense graded base and binder course
 Type C - Dense graded surface course
 Type D - Fine, dense graded surface course
 Type E - Curb mix

No bituminous concrete shall be placed on any frozen surface or when, in the opinion of the Engineer, weather conditions, such as wind and low temperatures, prevent proper spreading, finishing, and compaction of the mixture. Subsequent lifts or courses shall not be placed over another lift or course placed on the same day while the temperature of the previously placed mix is 140 °F (60 °C) or greater. Traffic shall be kept off the bituminous concrete until the mat temperature is less than 140 °F (60 °C).

The Contractor shall fill low places in the base with a leveling material consisting of hot-mix bituminous concrete base course or surface course material. The locations along the base course to receive this leveling course material, the type of material to be used, and the method to be employed in each case shall be as directed. Hot-mix bituminous concrete material shall be placed as directed around all manholes, drainage inlets, valves, or similar features (with slopes 20:1 or flatter) when they are adjusted to the proposed grade. This material may be temporarily placed and shall be removed if directed.

After the hot-mix bituminous concrete base course is placed, it shall not lay exposed for a period longer than ten days. If, due to conditions of emergency, more than ten days elapse, a fog coat of RS-1 or CSS-1-h shall be sprayed uniformly on the exposed base course before placing the wearing course of hot-mix bituminous concrete. In addition, the Contractor shall plan the paving operation so that no bituminous base courses remain unsurfaced after the "winter shut-down" unless authorized by the Engineer.

The paving operation shall be conducted to minimize inconvenience to traffic and to protect

existing and finished surfaces. Unless otherwise permitted, no single lane of any course shall be constructed to a length which cannot be completed to a full width of the pavement the following day. All hot-mix resurfacing operations shall be properly signed at the Contractor's expense with notice of "Pavement Drop-Off" or "Uneven Pavement" in accordance with the approved traffic control plans.

At locations where the hot-mix is tapered to meet an existing roadway, a tack coat of bituminous material shall be uniformly applied on the tapered area at the rate of approximately 0.15 gal/yd² (0.70 L/m²).

401.09 Deep Lift Base Course. In addition to other tolerances specified in this Section, deep lift bituminous concrete base course shall be constructed in accordance with the following requirements:

- (a) The base course shall be placed with an approved paver or spreader in approximately equal layers not exceeding 6" (150 mm) in depth after compaction.
- (b) Base course placed in irregular shaped areas of pavement, such as transitions, turning lanes, crossovers, and entrances, may be placed in a single lift using a grader.
- (c) Mix segregation will not be permitted regardless of method of placement. Should segregation occur, paving operations shall be stopped immediately and not resumed until the cause is determined and corrected.

401.10 Compaction. Immediately after the bituminous mixture has been spread and struck off, and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. The surface shall be rolled when the mixture is in the proper condition, and when the rolling does not cause undue displacement, cracking, or shoving. Delays in rolling freshly spread mixtures will not be permitted. The number, weight, and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition. The sequence of rolling operations and the selection of roller types shall provide the specified pavement density.

The rollers shall be operated with the drive wheels positioned toward the paver, at speeds slow enough to avoid displacement of the mixture. Rolling shall start longitudinally at the sides, parallel to the centerline of the work, and progress towards the center, overlapping on successive trips by at least one-half the width of the roller. Alternate trips of the roller shall be of slightly different lengths. When paving in echelon or paving a lane which abuts a previously placed lane, the longitudinal joint shall be rolled first, followed by the regular rolling procedure. On superelevated curves, the rolling shall begin at the low side and progress towards the high side by overlapping, longitudinal trips, parallel to the center line. All roller marks shall be rolled out.

The motion of the roller at all times shall be slow enough to avoid displacement of the hot mixtures. All displacement occurring as a result of the reversing of the direction of the roller, or from any other cause, shall be corrected to the satisfaction of the Engineer. To prevent adhesion of the mixture to the wheels of the roller, they shall be kept properly moistened, but excess water will not be permitted.

Along curb, headers, manholes, railroad crossings, and similar structures, and at all places not accessible to the roller, thorough compaction shall be obtained using approved tampers. At all contacts of this character the joints between these structures and the mixture shall be effectively sealed. All mixtures which become loose and broken, mixed with dirt, or in any way defective, shall be removed and replaced with fresh, hot mixture. The replacement mixture shall be immediately compacted to conform with the surrounding area. Areas showing an excess of asphalt cement, as determined by the Engineer, shall be removed and replaced.

401.11 Compaction Testing. Compaction shall be controlled by the following methods at the discretion

of the Engineer:

- (a) Bituminous mixtures shall be compacted to a degree of compaction of not less than 92% of the theoretical voidless density obtained by laboratory calculation for surface courses and not less than 90% of the theoretical voidless density obtained by laboratory calculation for base and binder courses. Laboratory compaction is the average density obtained by the Maximum Specific Gravity in accordance with AASHTO T 209 for the mixtures being produced and being placed. The degree of compaction shall be determined through measurement of actual pavement density using a nuclear density gauge in accordance with ASTM D 2950 and a laboratory compacted specimen density using the Maximum Specific Gravity and shall be expressed as a percentage:
- (b) At the option of the Engineer, 4" (100 mm) diameter, diamond-bit drilled roadway cores shall be obtained from the constructed pavement mixtures for laboratory pavement density determination in lieu of the nuclear method.
- (c) When theoretical voidless density values are not immediately available, or at the option of the Engineer, pavement compaction may be monitored by measuring the in-place density using a nuclear density gauge and comparing it to a control strip target density. The mean pavement compaction shall be at least 98% of the control strip target density and sufficiently uniform that individual test results are at least 96% of the control strip target density. If any individual test result falls below 96% of target density, the mixture represented by the test will be considered defective and the Contractor shall further compact the subplot. After further compaction, the original test site and one other randomly selected site within the subplot will be tested. The average of the two test results will be included in the mean density for that day's production. The original test will not be included.
- To determine the control strip target density, a control strip with a minimum length of 3002 (90 m) shall be constructed at the beginning of work on each pavement course. Each control strip is to remain in place and become a section of the completed roadway. A control strip shall have an area of approximately 400 yd² (325 m²) and shall be the same depth specified for the pavement course which it represents. The materials used in the construction of the control strip shall conform to the requirements of the approved job mix formula. They shall be furnished from the same source and shall be of the same type used in the remainder of the pavement course represented by the control strip. The prepared base upon which a control strip is to be constructed shall have the prior approval of the Engineer.
- The equipment used in the construction of the control strip shall be approved by the Engineer. It shall be of the same type and weight to be used on the remainder of the pavement course represented by the control strip.
- Compaction of the control strip shall commence as soon as possible after the mixture has been spread to the desired thickness, and shall be continuous and uniform over the entire surface. Compaction of the control strip shall be continued until no appreciable increase in density can be obtained by additional roller passes. Upon completion of the rolling, the mean density of the control strip will be determined by averaging the results of ten nuclear density tests taken at randomly selected sites within the control strip. The mean density of the control strip shall be the target

density for the remainder of the pavement course which it represents. Compaction shall be expressed as a percentage of the target density:

$$\text{Percent Compaction} = \frac{\text{Nuclear Pavement Density}}{\text{Control Strip Target Density}} \times 100$$

If the mean density of the control strip, as determined by cored samples taken in accordance with AASHTO T 230 Method B is less than 95% of the density of laboratory compacted specimens for surface mixtures, or 90% for base mixtures, the Engineer may order the construction of another control strip.

A new control strip may also be ordered by the Engineer if requested by the Contractor when:

- (1) A change in job mix formula is made
- (2) A change in the material from the same source is observed
- (3) There is reason to believe that a control strip density is not representative of the bituminous mixture being placed.

If the densities are not obtained, additional rolling or the use of more approved rollers will be required. All roller marks shall be rolled out.

401.12 Joints. Placing of bituminous concrete shall be as nearly continuous as possible. The roller shall not pass over the unprotected end of the freshly laid mixture except when necessary to form a transverse joint. When necessary to form a transverse joint between old and new pavement or between successive day's work, the joint shall be made by placing a bulkhead or tapering the course. If the course is tapered, the edge shall be cut back to its full depth and width on a straight line to expose a vertical surface to remove the taper prior to placing the next section. It is not the intent of this Section to require an existing (old) pavement to be cut back full depth transversely when the paving work being performed is an overlay tie-in unless such is designated in the Special Provisions or on the Plans. With either method, all contact surfaces shall be coated with an approved tack material before placing any fresh mixture against the joint.

Longitudinal joints shall be rolled directly behind the laying operations. The first lane shall be true to line and grade and have a vertical face. The material being placed in the abutting lane shall be tightly compacted against the vertical face of the previously placed lane. The finishing machine shall be positioned so that the spread material overlaps the edge of the lane previously placed by 1 to 2" (25 to 50 mm), and is left sufficiently high to allow for compaction. Before rolling, the material overlapping the joint shall be carefully deposited adjacent to the joint of the unrolled lane with a lute. When the abutting lane is not placed the same day, or the joint is distorted by traffic or other means, the edge shall be carefully trimmed to line and coated uniformly with tack material. The longitudinal joint in any layer shall offset that in the layer immediately below by approximately 6" (150 mm). However, the joints in the completed surfacing shall be at the lane line.

401.13 Surface Requirements. After final rolling, the surface will be tested longitudinally and transversely by the Engineer using a 102 (3.048 m) rolling straightedge or straightedge at locations selected by the Engineer. The distance between the surface and the testing edge of the straightedge between any two contact points shall not exceed the following limits:

- (a) For Base Courses:
 - (1) Lower courses: $\pm 3/8"$ (± 10 mm)
 - (2) Top course: $\pm 1/4"$ (± 6 mm)
- (b) For Surface Courses:

401 HOT-MIX, HOT-LAID BITUMINOUS CONCRETE PAVEMENT

(1) Multiple and single course construction: $\pm 1/4"$ (± 6 mm)

Areas found to exceed these tolerances shall be corrected, or removed and replaced by the Contractor, as directed, to conform to the required surface tolerances.

The Contractor shall have available at all times an approved 102 (3.048 m) straightedge for use by the Engineer.

SECTION 402 - HOT-MIX BITUMINOUS CONCRETE AND COLD-LAID BITUMINOUS CONCRETE FOR TEMPORARY ROADWAY MATERIAL (TRM)

402.01 Description. This work consists of furnishing and placing hot-mix bituminous concrete and cold-laid bituminous concrete as temporary roadway material (TRM) for the maintenance and repair of the roadway, for pipe and utility crossings, for driveways and entrances, for temporary ramps up to curbs, and for other areas as directed by the Engineer. TRM under this Section shall not be used for constructing detour roads or other temporary roadway; however, it can be used for their maintenance.

402.02 Materials. Materials for TRM shall conform to the following Sections:

Cold-Laid Bituminous Concrete	815
Hot-Mix Bituminous Concrete	823

402.03 Construction Methods. Repair of the existing pavement and the placement of TRM, hot or cold, shall be done as approved or directed by the Engineer. The work shall be coordinated with all other work and operations necessary to maintain traffic.

SECTION 403 PLANT MIX OPEN-GRADED WEARING SURFACE

403.01 Description. This work consists of furnishing all materials for and constructing an open-graded wearing surface.

403.02 Materials. Materials for open-graded wearing surfaces shall conform to the requirements of Section 823. An approved heat-stable, anti-stripping agent shall be added to all asphalt cement used for open-graded wearing surfaces.

EQUIPMENT.

403.03 Hauling Equipment. All requirements of Subsection 401.04 shall apply.

403.04 Pavers. All requirements of Subsection 401.05 shall apply.

403.05 Rollers. Rollers shall be in good condition and be capable of reversing without backlash. The use of equipment which results in crushing of the aggregate will not be permitted. Rollers shall be steel wheeled capable of exerting a load of not less than 250 lb/in (4.5 kg/mm) of width of compression roll or rolls. Rubber tired rollers will not be permitted on the open-graded wearing surface.

CONSTRUCTION METHODS.

403.06 Placement. The pavement shall be constructed in conformance with the requirements of all applicable Subsections of Section 401.

The mix shall be spread and struck-off to the grade and elevation established. Bituminous pavers shall be used to distribute the mixture either over the entire width of the roadway or over such partial width as may be practicable. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture may be spread and luted by hand tools.

No open-graded wearing surface shall be placed when the ambient temperature is below 65 °F (18 °C).

403.07 Compaction. After the bituminous mixture has been spread and struck off, and the surface irregularities adjusted, the mixture shall be thoroughly and uniformly compacted by rolling. The bituminous mixture shall be rolled in a longitudinal direction, commencing at the outside edge of the roadway and progressing towards the center. Rolling shall be accomplished with a steel-wheeled roller or rollers, conducted in such a manner that shoving, distortion, or stripping will not develop beneath the roller. On superelevated curves, the rolling shall commence on the low side and progress to the high side. The amount of rolling shall be limited to only that necessary for consolidating the bituminous mixture and bonding it to the underlying surface. Excessive rolling shall be avoided.

The completed bituminous mixture shall be protected from all traffic until it has cooled sufficiently to resist distortion, abrasion, or pickup.

The Contractor is advised that early breakdown is essential due to rapid temperature loss of the open-graded mix. It is anticipated that two complete passes of the roller will provide adequate compaction. Density tests on the open-graded wearing surface will not be conducted. The Contractor will be directed to cease rolling when, in the opinion of the Engineer, maximum density has been achieved. Determination will be by visual means. Over-rolling will result in aggregate fracture, which

shall be avoided.

403.08 Joints, Trimming Edges, and Cleanup. Placing of the bituminous mixture shall be as continuous as possible. Rollers shall not pass over the unprotected end of a freshly laid mixture unless authorized by the Engineer. Transverse joints shall be formed by cutting back the previous run to expose the full depth of the course. A tack coat shall be used on the contact surfaces of transverse joints just before additional mixture is placed against the previously rolled material.

The exposed edges of the completed mat shall be cut off true to the required lines. Material trimmed from the edge, and all other discarded bituminous mixture, shall be removed from the roadway and disposed of by the Contractor.

403.09 Finished Work Samples. The Engineer may cut samples from the pavement for testing. Samples will be neatly cut by a saw or core drill. The Contractor shall supply and place new material to backfill voids left by sampling.

SECTION 404 BITUMINOUS SURFACE TREATMENT

404.01 Description. This work consists of constructing one or more courses of bituminous material and aggregate upon the completed and accepted foundation or existing surfacing.

MATERIALS.

404.02 Asphalt. The asphalt for bituminous surface treatment shall be RC-70 or CRS-1 for the prime coat and RC-250 or CRS-2 for seal coats. All material shall conform to the requirements of Section 811 or 817 whichever is applicable.

The material used shall be applied within the following temperature limits:

Material	Limits
RC-70	80 to 150°F (27 to 66°C)
RC-250	100 to 175° F (38 to 79° C)
CRS – 1	70 to 140°F (21 to 60°C)
CRS – 2	125 to 185°F (52 to 85°C)

404.03 Coarse Aggregate. Coarse aggregate shall conform to the following requirements:

- (a) Coarse aggregate for the initial treatment may consist of crushed slag composed of clean, tough, durable pieces of air-cooled blast-furnace slag, reasonably uniform in density and quality, and free of glassy particles, coke, dirt, or other objectionable matter.
- (b) Crushed slag in dry condition shall weigh not less than 70 lb/ft³ (1120 kg/m³) when tested according to AASHTO T 19/T 19M, Rodded Method.
- (c) Coarse aggregate for initial treatment may also be crushed stone or crushed gravel weighing not less than 95 lb/ft³ (1520 kg/m³) when tested according to AASHTO T 19/T 19M and conforming to the requirements of Section 805.
- (d) The slag, crushed stone, or crushed gravel shall conform to the grading requirements of Section 813, Delaware No. 57 or 67.
- (e) Coarse aggregate for the two treatments following the initial application shall consist of crushed chips composed of crushed stone, crushed gravel, or crushed slag, conforming to the requirements of Section 813, Delaware No. 8.

404.04 Fine Aggregate. Sand for tack coat shall conform to the requirements of Section 804.

EQUIPMENT.

404.05 Distributors. The distributors used shall be capable of uniformly applying the bituminous material in liquid form. Devices to control the pressure, volume, and temperature shall be provided. Each distributor shall have an approved calibration chart, be equipped with an approved sampling device, and conform to the following:

- (a) *Pressure.* The pressure shall be supplied by a positive displacement pump or air compressor. The pressure shall be uniform throughout the entire width of spray. If pressure is supplied by an air compressor, automatic controls must be provided to maintain sufficient and even pressure throughout the application of an entire load.
- (b) *Temperature.* The distributor shall be equipped with a heating system that applies heat uniformly across the width of the tank. Provisions shall be made for circulating or agitating the material whenever necessary while heating. The distributor shall be equipped with a thermometer marked in degrees Fahrenheit (Celsius) of sufficient range to determine the actual temperature of the material.
- (c) *Tachometer.* All distributors shall be provided with an approved tachometer recording feet (meters) per minute with a tabulation of feet (meters) per load with adjustments. Each load tabulation shall start at zero. There shall also be a totaling tabulation of this instrument.

- (d) *Volume.* A tachometer shall give correct readings of the speed, and the volumetric efficiency of the distributor shall ensure the correct volume at various speeds. Tests shall be required to prove the volumetric efficiency of the distributor at various speeds as directed by the Engineer.
- (e) *Circulating System.* All pump distributors shall be equipped with a circulating system designed to maintain a homogenous liquid while circulating in the distributor tank. This circulating system shall also be arranged to circulate the material in the tank truck before application.
Air distributors shall be equipped with a device for agitating the bituminous material in the tank trucks when necessary.
- (f) *Tests.* Necessary tests shall be made to determine the accuracy of all pressure gauges, tachometers, and pump efficiencies. The tests shall be made by the Contractor when and as required.
- (g) *Spray Bars.* Each distributor shall be equipped with spray bars capable of applying material uniformly throughout the entire length of the spray bars when they are extended. Spray bar extensions shall be provided for applying up to a 242 (7.3 m) width in one operation. Spray bars shall be equipped with a cleaning device and a shut-off valve to prevent dribbling, dripping, or streaking.
- (h) *Tank Capacity Gauge.* A float or other approved type tank capacity gauge shall be furnished to indicate the volume in the tank in not less than 25 gal (100 L) units. The gauge shall have adjustments for correction.

Tanks shall have a minimum capacity of 750 gal (2800 L).

If the Engineer deems that the equipment applying the material is inadequate or fails to comply with all regulations, the Engineer will order the equipment to be removed from the job and require that another unit be placed on the work.

404.06 Mechanical Spreader. The Contractor shall furnish and operate at least one approved mechanical spreader capable of receiving the material to be spread and being accurately adjusted to distribute the aggregate uniformly at a regulated truck speed.

404.07 Broom Drag. A broom drag shall be furnished and used on the initial application of coarse aggregate. The broom drag shall be a non-revolving type, at least 152 (4.5 m) in length, and shall have at least four rows of brooms. One row must be at each end of the drag.

404.08 Rollers. The Contractor shall furnish and operate at least two power rollers. One power roller shall be three-wheeled, rated by the manufacturer to be between 5 and 8 tons (4500 and 7300 kg). The other power roller shall be a self-propelled, pneumatic-tired roller of approved design and weight, unless otherwise directed.

The tires of the rubber tire roller shall be uniformly inflated. The difference between the pressure in any two tires shall never be greater than 5 psi (35 kPa). The Contractor shall provide means for checking the tire pressure on the job at all times.

CONSTRUCTION METHODS.

404.09 Seasonal and Weather Limitations. Surface treatment shall not be applied during the following conditions:

- (a) on any wet or frozen surface,

- (b) when the ambient temperature is below 50 °F (10 °C)
- (c) between October 1 and April 15, without written permission from the Engineer, and,
- (d) when the weather conditions prevent the proper completion of the work, as determined by the Engineer.

404.10 Application. The bituminous surface treatment shall be completed according to the following procedure.

The first application of bituminous material shall not be applied until the moisture content of the foundation is within 2% of the optimum moisture content and the roadway has been properly shaped and approved. An initial application of priming asphalt shall be applied at the rate of approximately 0.5 gal/yd² (2.3 L/m²). Then, approximately 50 lb/yd² (27 kg/m²) of stone or 40 lb/yd² (22 kg/m²) of slag shall be spread from a mechanical spreader. After the initial treatment, two treatments shall be applied using approximately 0.30 gal/yd² (1.4 L/m²) of sealing asphalt and from 17 to 20 lb/yd² (9 to 11 kg/m²) of crushed chips for each application. If slag is used, approximately 0.35 gal/yd² (1.6 L/m²) of sealing asphalt shall be used for each treatment.

404.11 Heating and Application of Bituminous Material. Bituminous materials used for each treatment shall be heated in a manner that ensures even heating of the entire mass and maintained within the specified temperature and pressure range during application. Any material which has been damaged shall be rejected, and any section treated with damaged material shall be removed and replaced.

The bituminous material shall be applied in one application at the rates specified using the pressure distributor for the full width of the treatment, unless otherwise directed.

The nozzles of the spray bar shall be kept clean at all times. If one or more nozzles becomes blocked during the application of bituminous materials, the distributor shall be stopped immediately, and the nozzles shall be cleaned. The streaked areas shall be made uniform using a hand hose or other approved methods.

Joints shall be made by an approved method that ensures proper seal with the preceding application. All excess bituminous material at the transverse junction between distributor loads shall be removed and corrected in a satisfactory manner.

If the Contractor is unable to keep the application uniform, the operation shall be discontinued until a more experienced operator or a better distributor, or both, can be provided; or, the Contractor shall take such other precautions as may be necessary to keep the application within specified limits.

When applying bituminous materials adjacent to structures or curbs, the Contractor shall furnish and use effective means of protecting the structures or curbs from discoloration.

404.12 Spreading of Coarse Aggregate. As soon as the bituminous material has been applied, it shall be uniformly covered with the specified amount of coarse aggregate. The aggregates shall be applied immediately after the application of the bituminous material for prime and seal coats.

Spreading shall be done directly from trucks using approved mechanical spreaders. Trucks or spreaders shall not drive on the uncovered bituminous material.

During the spreading of coarse aggregate, a crew equipped with hand brooms shall broom all areas where the aggregate has been unevenly applied. Additional aggregate shall be placed by hand on all areas not properly covered. If directed, the surface shall then be dragged with a light broom drag until a smooth and even surface is obtained.

404.13 Rolling of Coarse Aggregate. Immediately after brooming and dragging, the coarse aggregate shall be rolled in a longitudinal direction with an approved pneumatic-tired roller or rollers. The rolling

shall begin at the outer edges of the treatment and progress toward the center, each pass overlapping the previous pass by one-half the width of the roller. This rolling shall be continuous. Enough rollers will be required to complete the rolling operation within one hour after the application of the asphalt. The rolling shall be repeated as often as required to ensure thorough keying of the coarse aggregate into the bituminous material.

404.14 Application of Sand. Sand shall be applied to asphaltic tack coats at the rate of approximately 10 lb/yd² (5.4 kg/m²) by means of approved mechanical spreaders or as directed.

404.15 Opening to Traffic. The roadway shall not be opened to traffic after the application of the treatments until bituminous materials have set and the coarse aggregate has embedded sufficiently to prevent picking up or whipping off by traffic.

Signs, barricades, lights, and necessary incidentals for detouring traffic shall be furnished and maintained by the Contractor.

SECTION 405 - BITUMINOUS SURFACE RETREATMENT

405.01 Description. This work consists of one or more applications of bituminous material followed by one or more applications of cover aggregate applied to a surface.

405.02 Materials. Materials shall conform to the requirements of Subsections 404.02 and 404.03.

405.03 Construction Methods. All provisions of Section 404 shall govern except as follows:

- (a) The Contractor shall furnish all equipment, tools, labor, and incidentals required to prepare the traveled way so that it will be free from deposits of dirt, loose stone, or other

objectionable material before applying the bituminous material. Each surface or section of the traveled way must be approved before applying the bituminous material.

- (b) Prime coats shall be omitted.
- (c) The bituminous material application rate may be varied as directed.
- (d) The covering aggregate shall be applied at approximately 17 lb/yd² (9 kg/m²), but may be varied as directed.

SECTION 406 HOT-MIX PATCHING

406.01 Description. This work consists of hot-mix patching portland cement and bituminous concrete pavement.

406.02 Materials. Hot-mix bituminous patching material shall conform to the requirements of Section 823.

Graded aggregate base course shall conform to the requirements of Subsection 302.02.

406.03 Construction Methods. Construction methods shall conform to the applicable Subsections of Sections 401 and 302.

The pavement shall be sawed before patching using a concrete cutting machine mounted on a sturdy frame equipped with control devices and a suitable-motor driven-diamond blade circular cutter. The equipment shall be capable of cutting a groove in a straight line to a sufficient depth so that an even, neat joint is cut to allow removal of material without damage to adjacent paving. Water shall be continuously supplied to the cutting element either by a water tank on the equipment or other means.

If the pavement is other than portland cement concrete, the equipment for cutting shall be of a type approved by the Engineer.

SECTION 602 CONCRETE STRUCTURES

602.01 Description. This work consists of furnishing and placing portland cement concrete for structures and incidental construction.

MATERIALS.

602.02 Materials. Materials for concrete structures shall conform to the following Section and Subsections:

Materials for Sealing Joints:

Preformed Elastomeric Compression Seals	808
Rubber Joint Sealant	808
Hot Poured Joint Sealer	808
Preformed Expansion Joint Fillers, Type III	808
Portland Cement Concrete	812.02
Chemical Admixtures	812.02
Curing Materials:	
Liquid Membrane Compounds	812.02
Polyethylene Sheeting	812.02
Waterproof Paper	812.02
Concrete Mix Composition, Classes A, B, C, and D	812.04
Bar Reinforcement	824.01
Bar Reinforcement, Epoxy Coated	824.02

602.05 Sheet Metal For Flashing and Waterstops. Sheet copper shall conform to the requirements of ASTM B 370. Sheet lead shall conform to the requirements of ASTM B 29. Sheet zinc shall conform to the requirements of ASTM B 69.

602.06 Form Oil For Concrete Formwork. Form oil shall be a nonstaining petroleum distillate free from water, asphaltic, and other insoluble residue or equivalent product.

602.07 Waterstops. Waterstops shall be polyvinyl chloride (PVC) compounded as necessary to conform to the requirements of U.S. Army Corps of Engineers Specification CDR-C572. No reclaimed PVC from any sources shall be incorporated in the compounding. The extruded material shall be dense, homogeneous, and free from porosity or other imperfections that could affect its durability or performance.

CONSTRUCTION METHODS.

602.08 Formwork. Except where indicated elsewhere in this Section, forms shall be designed and constructed so they can be removed without injuring the concrete. Forms shall be designed for strength and deflection to resist all loads and pressures of the wet concrete, the weight of the forms, the rate of pour, the affect of vibration, the time of setting, and an addition of 50 lb/ft² (2.4 kPa) of construction live load applied to all horizontal surfaces.

For removable forms, no member shall have a deflection, under total load, in excess of 1/360 of its span length, and in no case shall the deflection exceed ¼" (6 mm), except that deflections of form surfaces for concrete floor slabs where such forms are supported by beams, stringers, or girders may be 1/180 of the span length but not to exceed ½" (13 mm). Where the design of the forms requires deflections in excess of these amounts, the forms shall be cambered.

Concrete shall be assumed to weigh 150 lb/ft³ (2400 kg/m³). Lumber in forms shall be assumed to weigh 4lb per board foot (700 kg/m³). For all other materials, other than lumber in forms, the unit weight of the material shall be used.

Formwork plywood (without backing) shall be used with the face plies running parallel to the span (or perpendicular to supports) for maximum working strength and minimum deflection.

The Contractor shall prepare and submit for approval complete detailed plans of all formwork to be constructed. Working formwork drawings shall be submitted in accordance with Subsection 105.04. The Contractor shall not proceed with formwork construction until its plans have been approved. However, approval of these plans shall not relieve the Contractor of complete responsibility for the safety and adequacy of all formwork.

The form drawings shall show all major design values and loading conditions. These include assumed values of live and dead load, rate of placement, temperature of concrete, height of drop, weight of moving equipment which may be operating on formwork, foundation pressures, design stresses, deflection and camber diagrams, and other pertinent applicable information. All pertinent design calculations shall be submitted for walls greater than 10' (3 m) in height. In addition to specifying types of materials, sizes, lengths, and connection details, formwork drawings shall provide for applicable details such as: 1) Anchors, shores, and braces; 2) field adjustment of the form during placing of concrete; 3) waterstops, keyways and inserts; 4) working scaffolds and runways; 5) weepholes or vibrated holes where required; 6) screed and grade strips; 7) crush plates or wrecking plates; 8) removal of spreaders or temporary blocking; 9) cleanout holes; 10) construction, control and expansion joints; 11) chamfer strips; 12) notes to cover conduits and pipes to be embedded; and 13) details on shoring, reshoring, or leaving original shores in place as forms are stripped.

The material to be used for forms for exposed surfaces shall be either plywood, metal in which all bolts and rivet holes are countersunk, fiber, or other approved material. In either case, a plain, smooth surface of the desired contour must be obtained. For surfaces to be given a rubbed finish, the material shall be plywood unless otherwise specifically approved. For curved or special surfaces, the above requirements may be modified.

The form material shall be placed so a smooth surface free from irregularities is obtained. Sheets of material shall be placed so that joints are in regular and true horizontal and vertical lines. Full sized plywood sheets shall be used except where a single smaller piece covers an entire area. Where form lining is used, it shall be used in pieces as large as possible. All joints shall be solidly backed, butted tightly together, and sealed with white lead paste or other approved crack fillers. All holes shall be filled as well as depressions or hammer marks so that the completed surface is as smooth as possible. When steel forms are used, the panels shall be as large as practical and of sufficient thickness to prevent surface irregularities. Panels shall be assembled in uniform patterns and firmly locked and braced

together to form a smooth surface. Bent or irregular panels shall not be used. Round fiber column forms shall be furnished full height and shall be fitted with circular wooden templates at top and bottom and with wooden collars at intermediate points. Fiber forms shall be removed not later than ten days after pouring.

Moldings, fluting, rustification, and other ornamental details shall be formed of material specifically manufactured for the job. Samples or details of the material shall be submitted for approval by the Engineer prior to use.

All lumber shall be free from knotholes, loose knots, cracks, splits, warps, or other defects impairing the strength or the appearance of the finished structure.

When necessary because of thin wall construction, forms shall be daylighted at intervals not greater than 10' (3 m) vertically, the openings being sufficient to permit free access to the forms for the purpose of inspecting, working, and vibrating the concrete.

The forms shall be built true to line and braced in a substantial and unyielding manner. They shall be mortar tight and, to close cracks due to shrinkage, shall be thoroughly soaked with water.

Dimensions affecting the construction of subsequent portions of the work shall be carefully checked after the forms are erected and before any concrete is placed. The interior surfaces of the forms shall be adequately oiled, greased, or soaped to ensure non-adhesion of mortar. Form plywood and/or lumber which is reused shall be free from bulge, warp or damage and shall be thoroughly cleaned. The forms shall be inspected immediately preceding the placing of concrete and any defects shall be remedied and all dirt, sawdust, shavings, or other debris within the forms shall be removed.

Blocks and bracing shall be removed with the forms and in no case shall any portion of the wood forms be left in the concrete. Special attention shall be paid to the ties and bracing and when forms appear to be insufficiently braced or unsatisfactorily built, either before or during construction, the work will be ordered stopped until the defects have been corrected. The forms shall be so constructed that the finished concrete shall be of the form and dimensions shown on the Plans and true to line and grade.

On the structures having cement concrete masonry decks, supported by beams and girders, the forms for the deck slabs shall be so constructed that under full dead load, the slabs will be of the required thickness shown on the Plans and the surface of the roadway will accurately conform to the profile grades, cross-sections and alignments as shown on the Plans. Allowance shall be made for the camber of the beams and stringers as fabricated and erected and also for the additional deflections due to dead load. The depth of haunches between the top of the stringers and the bottom of the slab as shown on the Plans, is theoretical, and due to variations in obtainable camber in the stringers and to usual inaccuracies of fabrication and erection, the depths of haunches to be constructed may vary considerably from the theoretical. The formwork shall be constructed so as to provide for any and all necessary variations in actual depths of haunches required.

602.10 Placing Concrete. No concrete shall be placed until the depth of the excavation and character of the foundation material, the adequacy of the forms and falsework, and the placing of reinforcement and other embedded items have been inspected and approved by the Engineer.

Concrete shall be placed in daylight unless an adequate lighting system meeting the approval of the Engineer is provided.

In preparation for the placing of concrete, all sawdust, chips, and other construction debris and extraneous matter shall be removed from the interior of forms. Hardened concrete and foreign matter shall be removed from tools, screeds, and conveying equipment.

The temperature of the concrete shall not be greater than 90 °F (32 °C), nor less than 50 °F (10 °C) at the time of placing, except where other temperatures are required in this Section. The temperature of concrete for bridge decks shall not exceed 85 °F (29 °C). During hot weather, the Contractor may be required to chill the mixing water, incorporate ice into the concrete mixture as part of the mixing water, or take other measures as prescribed in Section 812 to maintain concrete temperatures below the specified maximum temperatures. In addition, any combination of wind velocity, high air temperatures and low relative humidity, which, in the opinion of the Engineer, will impair the quality of fresh or hardened concrete due to rapid concrete moisture evaporation shall be sufficient cause to discontinue or prohibit concrete placement. The ACI Recommended Practice for Hot Weather Concreting will be used as a guide in assessing the hazards of hot weather.

No concrete shall be used which does not reach its final position in the forms within the time stipulated in Subsection 812.06.

Surfaces other than foundations on which concrete is to be placed shall be thoroughly cleaned and wetted immediately before placing concrete in order to facilitate bonding.

Placing of concrete shall be so regulated that the pressures caused by the wet concrete shall not exceed those used in the design of the forms.

The external surface of all concrete shall be thoroughly worked during the placing by means of tools of an approved type. During the placing of concrete, care shall be taken that the methods of compaction used will result in a surface of even texture free from voids, water, or air pockets, and that the coarse aggregate is forced away from the forms in order to leave a mortar surface.

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. Concrete may be placed with the aid of buckets, chutes, troughs, pipes, or conveyors. Open troughs or chutes shall be metal or metal lined and extend as nearly as possible to the point of deposit. Aluminum will not be permitted as the contact surface for concrete placed through any conveyance.

Chutes on steep slopes shall be equipped with baffle boards or be in short lengths that reverse the direction of concrete movement. Chutes shall not slope greater than 1:2 (vertical to horizontal) or less than 1:3 (vertical to horizontal). Concrete placed with chutes over 25' (7.6 m) long or not meeting these slope standards shall discharge into a hopper before distribution unless otherwise directed.

All chutes, troughs, and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run. The water used for flushing shall be discharged clear of the structure.

Dropping the concrete a distance of more than 5' (1.5 m) or depositing a large quantity at any point and running or working it along the forms will not be permitted, except that the 52 (1.5 m) limitation will not apply to the dropping of concrete into the forms for the walls of box culverts, or retaining walls unless directed by the Engineer.

Care shall be taken to fill each part of the form by depositing the concrete as near its final position as possible. The coarse aggregate shall be worked back from the forms and worked around the reinforcement without displacing the bars. After initial set of the concrete, the forms shall not be jarred

and no strain shall be placed on the projecting reinforcement or other items embedded in the concrete, except where unavoidable on structures being widened under traffic.

Concrete shall be placed in continuous horizontal layers, the thickness of which generally shall not exceed 10 to 12" (250 to 300 mm). However, slabs shall be placed in a single layer. When it is necessary in an emergency to place less than a complete horizontal layer in one operation, such layer shall terminate in a vertical bulkhead. In any given layer, the separate batches shall follow each other so closely that each one shall be placed and consolidated before the preceding one has taken initial set in order that the fresh concrete shall not be injured and there shall be no lines of separation between the batches. Each layer of concrete shall generally be left somewhat rough to secure efficient bonding with the next layer above. A succeeding layer placed before the underlying layer has become set shall be consolidated in a manner that will entirely break up and obliterate the tendency to produce a construction joint between the layers.

Layers completing a day's work or placed prior to temporarily discontinuing operations shall be cleaned of all laitance and other objectional material as soon as the surface has become sufficiently firm to retain its form. To avoid visible joints as far as possible upon exposed faces, the top surface of the concrete adjacent to the forms shall be finished being smoothed with a trowel.

Horizontal layers so located as to produce a construction joint at a location wherein a feather edge might be produced in the succeeding layer shall be so formed by inset formwork that the succeeding layer will end in a body of concrete having a thickness of not less than 6" (150 mm).

In no case shall the work on any section or layer be stopped or temporarily discontinued within 18" (450 mm) of the top of any face, unless the details of the work provide for a coping having a thickness of less than 18" (450 mm) in which case at the option of the Engineer, the construction joint may be made at the underside of the coping.

Care shall be exercised during the placement of concrete to minimize the coating of reinforcing steel, structural steel, forms, and other items which extend into areas involved in a subsequent placement. In the event coating of the steel does occur, no attempt shall be made to remove the mortar until after the concrete steel bond of the earlier placement has developed sufficiently to withstand a cleaning operation. Any coating of mortar on deformed bars which cannot be removed by hand brushing with a wire bristle brush, or by a light chipping action, will not have to be removed.

The method and manner of placing concrete shall be so regulated as to place all construction joints across regions of low shearing stress and in such locations as will be hidden from view to the greatest possible extent.

The operations of depositing and consolidating the concrete shall, in general, be conducted so as to form a compact, dense, impervious mass of uniform texture which will show smooth faces on exposed surfaces. Any section of concrete found to be defective shall be removed or repaired as directed by the Engineer.

If concrete operations are permitted to extend into the night, the work shall be brightly lighted so that all operations are plainly visible. Lighting requirements are indicated in Subsection 602.24.

602.13 Consolidation of Concrete by Vibration. Concrete, except that placed under water, or as otherwise approved, shall be compacted during and immediately after depositing by means of approved mechanical vibrating equipment.

Internal mechanical vibrators shall be of sturdy construction, with a cutoff switch at the vibrator, adequately powered and capable of transmitting vibrations to the concrete in frequencies of not less than 5000 impulses per minute and shall produce a vibration of sufficient intensity and amplitude to cause settlement of the concrete into place without a separation of the aggregates.

In using internal vibrators, the vibratory element shall be inserted into the concrete at the point of deposit and in the areas of freshly-placed concrete. The time of vibration shall be long enough to accomplish thorough consolidation of the concrete and complete embedment of the reinforcement, to produce a smooth surface free from honeycombing and air bubbles, and to work the concrete into all angles and corners of the forms. However, over-vibrating shall be avoided. Vibration shall continue in a spot only until the concrete has become plastic and shall not continue to the extent that pools of grout are formed. The correct length of time of vibration will depend upon the frequency of the vibration impulses per minute, the size of vibrators and the slump of the concrete.

Internal vibrators shall be applied at points uniformly spaced, not farther than the radius over which the vibration is visibly effective and shall be applied close enough to the forms to effectively vibrate the surface concrete. The vibration shall not be dissipated in lateral motion but shall be concentrated in vertical settlement in consolidating the concrete. Vibrators shall not be used to move concrete.

The vibrating element shall be inserted in the concrete mass a sufficient depth to vibrate the bottom of each layer effectively and in as nearly a vertical position as practicable. It shall be withdrawn completely from the concrete before being advanced to the next point of application.

To secure an even and dense surface free from aggregate pockets or honeycomb, vibration shall be supplemented by working or spading by hand in the corners or angles of the forms and along form surface while the concrete is plastic under the vibratory action.

A sufficient number of vibrators shall be employed so that at the required rate of placement thorough consolidation is secured throughout the entire volume of each layer of concrete. Extra vibrators shall be on hand for emergency use and for use when other vibrators are being serviced.

The use of surface vibrators to supplement internal vibration will be permitted only when satisfactory surfaces cannot be obtained by internal vibration alone, and only upon approval. Surface vibrators shall be applied only long enough to embed the coarse aggregate and to bring enough mortar to the surface for satisfactory finishing.

The use of approved form vibrators will be permitted only when it is impossible to use internal or surface vibrators. When permitted, they shall be attached to or held on the forms in such manner as to effectively transmit the vibration to the concrete and so that the principal paths or motions of the vibration are in a horizontal plane.

602.17 Finishing Concrete Surfaces.

- (a) *General.* All concrete surfaces shall be true, even, and free from open or rough places, depressions, or projections. The concrete in all bridge seats, parapets, sidewalks, curbs, railings, and walls shall be brought flush with the finished top surface and shall be struck off with a template and floated to a finish free from irregularities and true to line and grade.

All masonry bearing areas as prescribed in Subsection 605.29 shall be placed to the final elevation specified. They shall be bush-hammered down to within $\frac{1}{32}$ (6 mm) of the final elevation and ground with an approved device to a smooth, level, true plain surface which must be within $\frac{1}{32}$ (3 mm) of the prescribed bearing elevation. The concrete in the bearing area shall be poured high enough so that no part of the bearing area, after bush-hammering, is lower than the surrounding bridge seating surface.

Unless otherwise specified on the Plans, all surfaces shall be given an ordinary surface finish unless after form removal they are in such a condition that they cannot be repaired to the satisfaction of the Engineer. In these cases, the entire structural unit shall be given a rubbed finish.

- (b) *Ordinary Surface Finish.* Immediately following the removal of the forms, all fins and irregular projections shall be removed from all surfaces except from those which are not to be exposed or are not to be water-proofed. On all surfaces, the cavities produced by form ties and all other holes, honeycomb spots, broken corners or edges, and other defects shall be thoroughly cleaned, saturated with water, and carefully pointed and trued with a mortar of cement and fine aggregate mixed in the proportions used in the grade of the concrete being finished. Mortar used in pointing shall be not more than 30 minutes old. The mortar patches shall be cured as specified in Subsection 602.18. All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges.
- (c) *Rubbed Surface Finish.* After removal of forms, the rubbing of concrete shall be started as soon as its condition permits. Immediately before starting this work, the concrete shall be kept thoroughly saturated with water. Sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing to thoroughly set. The surface to be finished shall be rubbed with a medium coarse carborundum stone, using a small amount of mortar on its face. The mortar shall be composed of cement and fine sand mixed in proportions used in the concrete being finished. Rubbing shall be continued until all form marks, projections, and irregularities have been removed, all voids filled, and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place.
After all concrete above the surface being treated has been cast, the final finish shall be obtained by rubbing with a fine carborundum stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform color.
After the final rubbing is completed and the surface has dried, it shall be rubbed with burlap to remove loose powder and shall be left free from all unsound patches, paste, powder, and objectionable marks.
- (d) *Float Finish.* This finish, for horizontal surfaces, shall be achieved by placing an excess of material in the form and removing or striking-off the excess with a template, forcing the coarse aggregate below the mortar surface. Creation of a concave surface shall be avoided. After the concrete has been struck off, the surface shall be thoroughly worked and floated with a suitable wood, canvas, or cork floating tool. Before the finish has set, the surface cement film shall be removed with a fine brush in order to have a fine grained, smooth but sanded texture.

JP COURTS 3/17

State Project #MC0213000002

- (e) *Special Surface Finish.* As an alternative to the rubbed surface finish, an acrylic or latex bonded mortar finish may be used when and where designated in the Plans and Special Provisions.
- (f) *Tooled Finish.* A tooled finish shall be made on the surfaces previously spaded by cutting into the body of the concrete with a pointing tool or bush-hammer as indicated on the Plans.

602.18 Curing. All exposed surfaces shall be cured by one of the following methods:

- (a) *Water Methods.* The concrete shall be kept continuously wet by the application of water for a minimum period of seven curing days after the concrete has been placed.

When cotton mats, burlap, or earth or sand blankets are to be used to retain the moisture, the entire surface of the concrete shall be kept damp by applying water with a nozzle that so atomizes the flow that a mist and not a spray is formed, until the surface of the concrete is covered with the curing medium. The moisture from the nozzle shall not be applied under pressure directly upon the concrete and shall not be allowed to accumulate on the concrete in a quantity sufficient to cause a flow or wash the surface. At the expiration of the curing period, the concrete surface shall be cleared of all curing mediums.

- (b) *Membrane Curing Compound Method.* The entire surface of the concrete shall be sprayed uniformly with a liquid membrane curing compound conforming to the requirements of Subsection 812.02.

The membrane curing compound shall be applied after the surface finishing has been completed, and immediately after the free surface moisture has disappeared.

The surface shall be sealed with a single uniform coating of the specified type of curing compound applied at the rate of coverage recommended by the manufacturer or as directed by the Engineer, but not less than 1 gal/150 ft² (0.27 L/m²) of area. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. If the application of the compound does not result in satisfactory coverage, the method shall be stopped and water curing, as set out above, applied until the cause of the defective work is corrected.

At locations where the coating shows discontinuities, pinholes, or other defects, or if rain falls on the newly coated surface before the film has dried sufficiently to resist damage, an additional coat of the compound shall be applied immediately after the rain has stopped at the same rate specified herein.

Any curing compound adhering to a surface to which new concrete is to be bonded shall be completely removed by sandblasting, steel wire brushes, bush-hammers, or other approved means.

The concrete surfaces to which the compound has been applied shall be protected from abrasion or other damage which results in perforation of the membrane film for seven curing days after the concrete is placed. If the film of membrane compound is damaged or removed before the expiration of seven curing days, the exposed concrete shall be immediately cured by the water method until additional compound is applied or until seven curing days have expired.

In the event that the application of curing compound is delayed, the application of water shall be started immediately and shall be continued until application of the compound is resumed or started.

- (c) *Waterproof Sheeting Method.* The exposed finished surface of concrete shall be wetted with water, using a nozzle that so atomizes the flow that a mist and not a spray is formed, until the concrete has set, after which the waterproof sheeting shall be placed. Curing shall continue for seven curing days after the concrete has been placed. If the sheeting is damaged or removed before the expiration of seven curing days, the exposed concrete shall be immediately cured by the water method until additional sheeting is placed or until seven curing days have expired.

Waterproof sheeting shall consist of paper or polyethylene conforming to the requirements of Subsection 812.02. The waterproof sheeting shall provide a complete continuous cover of the entire concrete surface. Sheets shall lap a minimum of 123 (300 mm) and shall be securely weighed down or cemented together in such a manner as to provide a waterproof joint.

Should any portion of the sheets be broken or damaged before the expiration of the curing period, the broken or damaged portions shall be immediately repaired with new sheets properly cemented in place.

Sections of sheeting which have been damaged to such an extent as to render them unfit for curing the concrete shall not be used.

- (d) *Forms-In-Place Method.* Formed surfaces of concrete shall be cured by retaining the forms in place for a minimum period of seven days after the concrete has been placed.

If the Contractor elects to leave forms in place for a part of the curing period and use one of the other methods of curing included in this article for the remainder of the curing period, the concrete surfaces shall be kept wet during the time the curing methods are being changed.

methods of construction shall be modified as required to obtain satisfactory concrete in the slab. All unsatisfactory concrete shall be removed and repaired as directed by the Engineer.

The amount of sounding and form removal may be moderated, at the Engineer's discretion, after a substantial amount of slab has been constructed and inspected, if the Contractor's methods of construction and the result of the inspections as outlined above indicate that sound concrete is being obtained throughout the slabs.

The Contractor shall provide all facilities as are reasonably required for the safe and convenient conduct of the Engineer's inspection procedures.

- (b) *Concrete Work.* A smooth, durable riding surface of uniform texture, true to the required grade and cross-section, shall be obtained on all bridge decks.

Concrete shall be placed in accordance with the Contract. Particular emphasis should be placed on proper vibration of the concrete to avoid honeycomb and voids, especially at construction joints, expansion joints, and valleys and ends of form sheets. Pouring sequences, procedures, and mixes shall be approved by the Engineer.

The placing of concrete in bridge decks will not be permitted until the Contractor has satisfied the Engineer that it has adequate personnel and equipment to deliver, place, spread, finish, and cure a minimum of 20 yd³ (15 m³) of concrete per hour, that experienced finishing machine operators and concrete finishers are employed to finish the deck, and that weather protective equipment and all necessary finishing tools and equipment are on hand at the site of the work and in satisfactory condition for use.

Prior to any deck concreting, a "pre-pour" conference will be held with the Contractor and representatives of the Department in attendance. At this time, the Contractor shall present its plan and procedures for deck construction.

Supports for screeds or finishing machines shall be completely in place and firmly secured before placing of concrete will be permitted. Supports shall be set to elevations necessary to obtain a bridge deck true to the required grade and cross-section, with allowance being made for anticipated settlement. Supports shall be of a type and shall be so installed that no springing or deflection will occur under the weight of the finishing equipment, and shall be so located that finishing equipment may operate without interruption over the entire bridge deck being furnished.

Immediately prior to placing bridge deck concrete, the Contractor shall check all falsework and shall make all necessary adjustments. Suitable means such as telltales shall be provided by the Contractor to permit ready measurement by the Engineer of deflection as it occurs.

On continuous steel beam or girder spans, the order of casting shall be as shown on the Plans. On simple spans, and for any section between construction joints for continuous spans, the concrete in the floor slab may be placed by beginning at the end and working along the roadway or by beginning at the side and working across the roadway. The screeding method used shall have been approved by the Engineer.

Screeding operations shall include a mechanical screed of the power-actuated oscillating type. Vibrating screeds will not be permitted unless specifically approved by the Engineer. The screed shall be sufficiently rigid and easy to control in order to provide substantially uniform treatment over the deck surface. Screeds shall be of the transverse type and shall be of sufficient weight to strike off the surface at the specified grade. Longitudinal type screeds shall not be used without prior written approval from the Engineer.

When the longitudinal type screed is used, the over-all length shall be such as to screed independently supported spans up to and including 802 (24 m). In no case shall the length of the screed be less than the full length of the span for spans less than 802 (24 m). When using the longitudinal type screed on independently supported spans exceeding 802 (24 m) in length with a screed length less than the full length of the span, the center half of the span, preferably more, shall be completed first and then the remaining portions completed. Bulkheads or other substantial supports for the screed shall be placed over the abutments and/or piers and at the terminal point of placements within the span. The surface of a previously placed section shall not be used as a bearing area for the screed track until control cylinders have attained a minimum strength of $0.6 f_{2c}$ where f_{2c} is the design minimum laboratory compressive strength as specified on the Plans.

When a transverse screed is used, the screed shall be of a sufficient size to finish the full width of the deck between curbs or parapets unless a longitudinal joint in the deck is specified. In this case, the portion on either side of the joint shall be placed and finished separately. The wheels of the screed shall bear on temporary rails which shall be adequately supported on and directly above the main structural members or on form supports. In case of continuous spans, the form supports shall be fully supported by the principal structural members supporting the deck. The rails shall be sufficiently rigid and strong to permit the screed to finish the surface of the deck within the requirements of this Section. If the rails are placed within the roadway area, they shall be elevated a sufficient distance above the deck to permit the simultaneous finishing by hand of any portion not finished by the screed. Rail supports extending above the roadway surface shall be fabricated and installed in such a manner as to permit their removal to at least 23 (50 mm) below the top surface of the deck slab. Any portion of the rail support to remain in the deck concrete shall be fusion bonded epoxy coated. Where rail supports are placed in that portion of the deck under the curbs or parapets, the supports shall be so placed that they will be at least 23 (50 mm) from the face of the curb parapet walls or outside edge of the slab.

During the screeding operation, an adequate supply of concrete shall be kept ahead of the screed and a slight excess shall be maintained immediately in front of the screed. Workers will not be permitted to walk on the concrete after screeding. The Contractor shall provide a sufficient number of work bridges or other suitable platforms to provide adequate access to the work, and so that screeding, finishing, and curing operations can progress without delay. The work bridge shall be supported outside the limits of the concreting.

An adequate supply of suitable coverings which will protect the surface of the freshly placed bridge deck from rain shall be readily available at the site of the work.

Where the concrete in the deck of a continuous beam or girder span group cannot be placed in one operation, the location of construction joints and sequence of placement shall be in accordance with an approved placement schedule. After the initial placement has been made in any one group of a continuous span, no further placement shall be made until all previously placed concrete in the deck of that group has been in place for at least three days or until the cylinder strength is at least $0.5 f_{2c}$.

Roadway surfaces of bridge decks and approach slabs shall be wet cured, as soon as possible, according to Subsection 602.18 (a). Membrane curing compound shall not be used on bridge decks and approach slabs except when cold weather dictates its use. The Engineer will determine when cold weather requires membrane curing. When required, membrane curing compound shall be applied in accordance with the requirements of Subsection 501.11 immediately after the finishing operation. Within 24 hours, the roadway surfaces shall also be covered with waterproof covers as set forth in Subsection 501.13. The waterproof covers shall remain in place for not less than seven days. Extreme care shall be taken to protect adjacent reinforcing steel from the membrane curing compound.

The Contractor shall test the fresh concrete deck surface with a 10' (3.048 m) straightedge, and the Contractor shall rescreed the deck surface as many times as is necessary to ensure a smooth riding surface. The straightedge shall be held in successive positions at the edges, quarter points, and on the centerline, parallel thereto and in contact with the surface. Advancement along the deck shall be in successive stages of not more than one-half the length of the straightedge. The surface shall also be checked transversely at the ends, quarter points, and center of the span. Areas showing high spots or depressions of more than 1/8" (3 mm) in 10' (3.048m) in the longitudinal direction and 1/4" (6 mm) in 10' (3.048 m) in the transverse direction shall be struck off or filled with freshly mixed concrete as the case may be. Special attention shall be given to ensure that the surface across joints meets the requirements for smoothness.

After the deck has cured the surface will be tested using either a straightedge, a rolling straightedge, or a California-type profilograph. If surface testing using a California-type profilograph is required, testing and corrective work shall conform to the requirements of Subsection 501.17. Surface testing the cured concrete with a straightedge or rolling straightedge will be performed as described above for fresh concrete. High spots or depressions of more than 1/8" (3 mm) in 10' (3.048 m) in the longitudinal direction and 1/4" (6 mm) in 10' (3.048 m) in the transverse direction shall be corrected by patching and/or grinding at no cost to the Department. Any cracking which occurs prior to opening to traffic shall be sealed or repaired in a manner approved by the Engineer at no cost to the Department. The deck shall also be sounded and any delaminated areas shall be removed and replaced in a manner approved by the Engineer at no cost to the Department.

- (c) *Surface Texture.* All bridge deck surfaces shall be textured either by mechanical grooving or by manual texturing. Unless otherwise noted in the Contract, texturing will be done by mechanical grooving.
- (1) *Mechanical Grooving.* Bridge deck and approach slab surfaces shall be textured by first dragging a fabric over the final screeded concrete and then by sawing transverse grooves in the cured concrete. After final screeding of the surface, the Contractor shall drag multiple-ply damp fabric over the surface to provide a gritty texture. After the bridge deck or approach slab has been cured and attained 75% of the 28-day design compressive strength, the Contractor shall saw uniformly pronounced grooves transverse to the centerlines.
- Grooves shall be sawn approximately 1/10" (2.5 mm) wide, 1/8 to 3/16" (3 to 5 mm) deep, and on 1 1/2" (38 mm) (nominal) centers. Grooves shall terminate 18 ± 1 " (450 \pm 25 mm) from the face of the parapet. Grooves shall not be sawn any closer than 2" (50 mm) nor further than 33 (75 mm) from the edge of any joint. When the width of the cutting head on the grooving machine is such that grooves cannot be practically sawn to within the required tolerance for a skewed transverse joint, grooving shall begin on the side of the deck having the acute angle corner, and nominal spacing of the grooves at the starting point shall be 1 1/2" (38 mm) on center. In the event that a single pass of the grooving machine cannot be made across the width of the bridge or approach slab, then the mating ends of subsequent passes shall not overlap previous grooves nor leave more than 1" (25 mm) of surface ungrooved.
- For bridge lengths over 300' (90 m), a randomly spaced groove pattern shall be used. The random spacing shall be from 1 3/8" (35 mm) centers to 1 5/8" (40 mm) centers, as determined by the Engineer.
- Removal of all debris, including slurry, resulting from the grooving operations shall be continuous. Surfaces must be immediately left in a washed and clean condition, free of all slipperiness from the slurry. All debris and surplus material removed from the grooving operations shall be deposited in a truck, or other conveyance, and disposed.
- (2) *Manual Texturing.* When specified, after the concrete has been consolidated and struck off and before the concrete becomes non-plastic, the surface shall then receive a transverse texture. Texturing shall be done by use of a wire broom having a single row of tines or a finned float having a single row of fins. The broom or float shall produce transverse grooves that are spaced at intervals of approximately 1/2 to 3/4" (13 to 19 mm) center to center. The grooves in the hardened surface shall be approximately 0.08 to 0.12" (2 to 5 mm) in width and 0.15 to 0.25" (3 to 6 mm) in depth. The grooving shall be applied to the entire deck surface except that area within 18" (450 mm) from the face of curb.

602.21 Drainage and Weep Holes. Drainage openings and weep holes shall be constructed in the manner and at locations indicated on the Plans, or as directed. No deduction in the computed volume of concrete masonry, except for openings in pipe headwalls, will be made.

602.23 Placing Anchors, Bolts, Grills, and Other Embedments. Anchors, bolts, grills, and other embedments, which are to be placed in the concrete as indicated on the Plans, shall be furnished and placed by the Contractor during construction.

602.25 Defective Work. Any defective work discovered after the forms have been removed shall be immediately removed and replaced. If the surface of the concrete is bulged or uneven, or shows honeycombing that cannot be repaired satisfactorily, the entire section shall be removed and replaced.

Concrete which fails to reach full 28-day design strength (f'_{28}) will be considered defective concrete. If the concrete is determined to not be structurally adequate by the Engineer, then it shall be removed and replaced. If the concrete is determined to be structurally adequate by the Engineer and the concrete can remain in place, the Contractor shall have the following options:

- (1) Accept the low strength concrete test results and all remedial action as described in the below categories or;
- (2) Challenge the low strength concrete test result by coring the area which the test cylinders represent.

If the Contractor elects to take cores to challenge the cylinder strength results, it shall be the Contractor's responsibility to obtain two cores (one for the Department and one for the Contractor) at the location determined by the Engineer. After the cores have been obtained, the concrete cores shall be tested for compressive strength in the as-cored moisture condition and the Contractor's core testing results shall be provided to the Department no later than five working days after verbal notification that the cylinder strength test results were substandard.

If the average of the core testing results (Department and Contractor) are greater than or equal to the specified 28-day design strength, the Contractor shall be paid the full bid price for the concrete in question. If the average core testing results are less than the specified strength, the remedial action as described in the following categories will be required:

- Category A:* 0 to 250 psi (0 to 1.66 MPa) below 28-day Design Strength
No repair required, full payment as specified in Subsection 602.27.
- Category B:* 251 to 500 psi (1.67 to 3.33 MPa) below 28-day Design Strength
Prorated payment as specified in Subsection 602.27.
- Category C:* 501 to 1000 psi (3.34 to 6.66 MPa) below 28-day Design Strength
Prorated payment as specified in Subsection 602.27 plus the application of a protective waterproofing that is approved by the Department's Materials and Research Section. The coating shall be clear and shall only be applied to the pour area that the core represents.
- Category D:* 1000 psi (6.67 MPa) or greater below 28-day Design Strength
Strengthen area of low strength concrete as approved by the Engineer at no cost to the Department.

If the difference in strength between the Department's results and the Contractor's independent test laboratory results are greater than 501 psi (3.34 MPa), the core testing results will be considered void and the prorated payment as specified in Subsection 602.27 will be applied to the concrete in question based upon the field-cast cylinders.

DIVISION 700 MISCELLANEOUS CONSTRUCTION PORTLAND CEMENT CONCRETE

SECTION 701 CURB AND INTEGRAL CURB AND GUTTER

701.01 Description. This work consists of constructing curbs and integral curbs and gutters on a prepared foundation using either fixed forms or slip forms.

MATERIALS.

701.02 Portland Cement Concrete. Portland cement concrete shall conform to the requirements of Section 812, Class B for either fixed-form work or slip-form work.

701.03 Preformed Expansion Joint Material. Preformed expansion joint material shall be 1/2" (13 mm) nominal thickness and conform to the requirements of Subsection 808.06.

701.04 Bituminous Joint Sealant. Bituminous joint sealant shall conform to the requirements of Subsection 808.04 (c).

CONSTRUCTION METHODS.

701.05 Preparation of Foundation. The foundation shall be prepared at the required grade to accommodate the elevations, dimensions, and details shown on the Plans. Existing undisturbed soil, where used as foundation, shall be firm and unyielding. All unsuitable material shall be removed and replaced with approved material. When the foundation is to be any material other than existing undisturbed soil, the compaction and density requirements for the Section covering the material shall govern. Where rock is encountered, the grade shall be excavated to 6" (150 mm) below the bottom of the curb and integral curb and gutter and backfilled with approved material.

701.06 Fixed Forms. Fixed forms shall be of wood or metal and shall extend the full depth of the concrete. Composite material forms may be used for radii work. Forms shall be straight, free from warp, and of sufficient strength to resist the pressure of the concrete, and shall not displace more than 3/8" in 10' (10 mm in 3 m) from the vertical or horizontal plane. Forms shall remain in both horizontal and vertical alignment until their removal. Forms shall be clean and coated with an approved form release agent before concrete is placed. Divider plates shall be metal.

701.07 Slip-Forming. When slip-forming is permitted, contraction joints shall be constructed at 20' (6 m) intervals. All surfaces front, top, and back shall be tooled or sawed to a minimum depth of 1" (25 mm) and a minimum width of 1/8" (3 mm). Where slip-forming is used, expansion joints shall be constructed at radius points, structures, obstructions, and 200' (60 m) intervals.

701.08 Placing Concrete. The concrete shall be placed on a moist foundation between the forms, consolidated, and worked sufficiently to bring mortar to the surface. The surface shall be struck off to the required contour and finished smooth and even with an approved float.

Limitations on placing concrete during hot or cold weather shall be as specified in Subsection 501.04.

701.09 Construction of Sections. All transverse joints shall be sealed with approved joint sealant. The sealing shall be performed immediately after the concrete has cured for 72 hours. Longitudinal joints shall be tooled adjacent to rigid pavements and structures and sealed with approved joint filler. This work shall be constructed in sections having a uniform length of approximately 10' (3 m). Sections shall be separated by open joints at least 1/8" (3 mm) wide by use of steel templates. Templates shall be not less than 2" (50 mm) longer than the depth of the curb. Templates shall be secured during the placing of concrete and shall remain in place until concrete has set sufficiently. No sections shall be less than 5' (1.5 m) in length.

701.10 Expansion Joints for Fixed Forms. Expansion joints shall be formed in curb and in integral curb and gutter at 40' (12 m) intervals. When constructed adjacent to concrete pavement, expansion joints shall coincide with the expansion joints in the pavement.

701.11 Finishing. A wood or magnesium float shall be used to rub the surface smooth while the concrete is still green. A steel trowel finish shall next be applied, and finally a soft dampened brush shall be used longitudinally along the surface. Finishing shall be performed to a depth of 23 (50 mm) below the proposed pavement surface elevation.

Before the concrete is given the final finish, the flow line of the gutter shall be checked and any irregularities of more than 1/8" in 10' (3 mm in 3 m) shall be corrected.

Irregularities in grade or alignment of the exposed surfaces shall not exceed 3/8" in 10' (10 mm in 3 m). Vertical alignment shall be sufficiently uniform and regular to ensure complete drainage.

701.12 Removal of Forms. Front forms may be removed as soon as concrete has hardened sufficiently. Rear and side forms shall not be removed for at least 12 hours. Surfaces exposed after 12 hours but prior to 72 hours shall be cured using materials specified in Section 812 or immediately backfilled. Minor defects shall be filled with mortar conforming to the requirements of Section 611.

701.13 Curing. Immediately, upon the completion of finishing, all exposed surfaces shall be cured for 72 hours using curing materials specified in Section 812. During the curing period, pedestrian and vehicular traffic shall not disturb newly completed curb or integral curb and gutter.

701.14 Backfilling. As soon as possible after the removal of forms or completion of the slip-form operation, the spaces adjacent to the curb and integral curb and gutter shall be backfilled to the required elevation with suitable material until firm and solid.

SECTION 705 PORTLAND CEMENT CONCRETE SIDEWALK

705.01 Description. This work consists of constructing portland cement concrete sidewalk on a prepared foundation.

MATERIALS.

705.02 Portland Cement Concrete. Portland cement concrete shall conform to the requirements of Section 812, Class B.

705.03 Preformed Expansion Joint Material. Expansion joint material shall conform to the requirements of Subsection 808.06.

705.04 Curing Material. Curing materials shall conform to the requirements of Subsection 812.02 (i).

CONSTRUCTION METHODS.

705.05 Preparation of Foundation. The foundation shall be formed at the required grade to accommodate the elevations, dimensions, and details shown on the Plans for the bottom of the sidewalk. Where the sidewalk foundation is to be existing undisturbed soil, the foundation shall be firm and unyielding. All soft and yielding or other unsuitable material shall be removed and replaced with approved granular material. When the sidewalk foundation is to be any material other than existing undisturbed soil, the compaction and density requirements for the Section covering that material shall govern. Where rock is encountered, the grade shall be excavated to 6" (150 mm) below the bottom of the sidewalk, backfilled with approved granular material, and thoroughly compacted.

705.06 Forms. Forms shall be of wood or metal and shall extend the full depth of the concrete. Composite material forms may be used for radii work. Forms shall be straight, free from warp, and of sufficient strength to resist the pressure of the concrete, and shall not displace more than 3/8" in 10' (10 mm in 3 m) from the vertical or horizontal plane. Forms shall remain in both horizontal and vertical alignment until their removal. Forms shall be clean and coated with an approved form release agent before concrete is placed.

705.07 Placing and Finishing Concrete. The concrete shall be distributed to the required depth and for the entire width of the slab by shoveling, or an approved method which preserves the integrity of the mixture. Concrete shall be thoroughly spaded along all joints and on the inside of the forms for its entire depth. The concrete shall be leveled and immediately struck-off by means of an approved screed. The screed shall be shaped to the required crown and of sufficient strength to retain its shape under all working conditions.

While the concrete is still moist, it shall be floated with an approved float of either wood or metal to ensure that all irregularities or depressions are filled. The final finish shall be obtained by either a wood float or hair broom. Concrete shall be finished in accordance with Subsection 501.11. If concrete is permitted to be placed during cold weather, it shall be placed in accordance with Section 501.

SECTION 708 - DRAINAGE INLETS AND MANHOLES

708.01 Description. This work consists of the construction of reinforced portland cement concrete drainage inlets and manholes.

MATERIALS.

708.02 Portland Cement Concrete. Portland cement concrete shall conform to the requirements of Section 812, Class B.

708.03 Mortar. Mortar shall conform to the requirements of Section 611.

708.04 Bar Reinforcement. Bar reinforcement shall conform to the requirements of Section 824.

708.05 Castings. Castings for frames and covers shall conform to AASHTO M 105, Class 30. Castings shall be boldly filleted at angles, and the arises shall be sharp and exact. Castings shall be true to pattern in form and dimension and free from pouring faults, sponginess, cracks, blowholes, and other defects that impair the strength and value for the service intended.

708.06 Gratings. Gratings shall be fabricated as shown on the Plans and the Standard Construction Details from cast iron conforming to the requirements of ASTM A 48, Class 30.

708.07 Steps. Drainage inlet steps shall be of the type constructed of molded plastic with a reinforcing bar core, conforming to the requirements of AASHTO M 31/M 31M, and ASTM A 478, and D 4101.

CONSTRUCTION METHODS.

708.08 Excavation. Excavation shall be made to the required depth. The foundation upon which the concrete floor of the drainage inlet is to be placed shall be compacted to a firm, even surface.

708.09 Reinforced Concrete Construction. Reinforced concrete drainage inlets and manholes shall be constructed according to the requirements of Section 602.

708.10 Precast Drainage Inlets and Manholes. Precast drainage inlets and manholes shall be constructed as shown on the Standard Construction Details. The annular space of joints between precast sections shall be filled with a joint sealant meeting the requirements of AASHTO M 198.

708.11 Frames of Castings. Frames of castings shall be set in full mortar beds.

708.12 Steps. All drainage inlets and manholes which are 4' (1.2 m) or more in depth, measured from the top of grate or cover to the invert of the lowest pipe, shall have steps installed on the back wall or as specified on the Plans. The steps shall be embedded a minimum of 3" (75 mm) in the wall, protrude out 6" (150 mm) from the wall, start within 24" (600 mm) of the top of grate/lid, end no more than 12" (300 mm) above the lowest invert (except where a pipe is in the backwall), and be spaced vertically at 12" (300 mm) intervals.

708.13 Inlet and Outlet Pipes. Inlet and outlet pipes shall be the same size and type as the connecting pipes shown on the Plans and shall extend through the walls and be flush with the inside of the wall.

If an end of reinforced concrete pipe is cut off, the end shall be cut clean and smoothly finished with mortar so that no bar reinforcement remains exposed. Any space between the pipe and the walls of the precast drainage inlet shall be filled with non-shrink grout conforming to the requirements of ASTM C 1107. The greatest dimension of the opening in the drainage inlet for the pipe shall be no greater than the outside pipe diameter plus 4" (100 mm).

708.14 Backfill. The area around drainage inlets and manholes shall be backfilled with Borrow Type C material to the required elevation. Backfill placement shall be in 6" (150 mm), loose-thickness lifts. Each lift shall be placed and compacted to 95% or more of the maximum density. No backfill shall be placed prior to approval.

SECTION 714 DITCHING

714.01 Description. This work consists of excavating lateral and longitudinal ditches. This work also includes clearing alongside the ditches, as necessary.

714.02 Construction Methods. Ditches shall be excavated as shown on the Plans. All material excavated from the ditches shall be spread on top of the land on each side of the ditch, graded to conform to the surface contours, and blended into the surrounding ground. Where necessary, the land shall be prepared and conditioned in all sections along both sides of the ditch to the width necessary to receive the material. As necessary, the Contractor shall clear the brush alongside the ditches. Brush shall be disposed as specified in Subsection 106.09.

LANDSCAPING AND EROSION CONTROL SECTION 732 TOPSOIL

732.01 Description. This work consists of furnishing and placing topsoil for planting.

732.02 Materials. Topsoil shall be original surface friable loam topsoil of uniform quality and free from heavy clay, frozen clods, lumps, plants, roots, sticks, and foreign materials harmful to plant growth, such as fragments of hot-mix, concrete pavement, and surface treatment.

Topsoil shall be reasonably free of noxious perennial weeds or wood vegetation and completely void of Johnsongrass (*Sorghum halapense*) as determined through prior inspection by an authorized representative of the Department.

Topsoil shall have an acidity range of pH 6.0 to pH 7.5, and, if necessary, lime shall be applied, as directed by the Engineer, and incorporated with the furnished topsoil.

Topsoil shall contain not less than 2% nor more than 30% organic matter as determined in accordance with AASHTO T 194.

The method of testing topsoil shall be in accordance with the requirements of AASHTO T 88, Modified; AASHTO T 89, Method B; and AASHTO T 90; and shall meet the following gradation requirements:

JP COURTS 3/17
State Project #MC0213000002

Gradation Requirements

Sieve Size	Minimum Percent Passing by Weight
2" (50 mm)	100
No. 4 (4.75 mm)	90
No. 10 (2.00 mm)	80

	Minimum Percent	Maximum Percent
Passing No. 10 (2.00 mm) and retained on No. 200 (75 mm) sieve		
Sand	15	65
Passing No. 200 (75 mm) sieve		
Silt	10	60
Clay	5	40

Topsoil shall not be delivered until samples have been approved by the Engineer.

732.03 Areas From Which Obtained. Topsoil shall be secured from areas from which topsoil has not been previously removed either by erosion or mechanical methods, and it shall not be removed to a depth in excess of the depth approved.

The area or areas from which topsoil is secured shall possess such uniformity of material depth, color, texture, drainage, and other characteristics as to offer assurance that when removed in commercial quantities, the product is homogeneous in nature and conforms to the requirements of this Section.

CONSTRUCTION METHODS.

732.04 Clearing the Area. All areas from which topsoil is to be secured shall be cleaned of all brush, sticks, weeds, stones, bricks, ashes, and other refuse which may hinder or prevent growth.

732.05 Approval of Materials. In securing topsoil from an approved source, should strata or seams of materials be encountered which do not qualify as topsoil, such materials shall be removed from the topsoil or, if required, the source shall be abandoned.

732.06 Placing. Before placing or depositing topsoil upon any section as shown on the Plans, the foundation upon which the topsoil is to be placed shall be approved.

Topsoil shall be spread on these areas to a depth sufficiently greater than that specified on the Plans, so that after natural settlement has taken place the work shall conform to the elevations on the Plans.

732.07 Maintaining the Topsoil. The Contractor shall maintain the topsoil until final completion and acceptance of the Contract. Maintenance shall consist of preserving, protecting, replacing, and such other work as may be necessary to keep the topsoil in a satisfactory condition.

732.08 Final Cleaning. Upon the completion of this work, final cleaning shall be done within the limits of the Project and shall consist of completely cleaning the Project of excess material, sweeping pavements and structures of dirt and rubbish, and removing of any unused material which may mar the appearance of the Project.

SECTION 733 TOPSOILING

733.01 Description. This work consists of refertilizing and placing the topsoil which has been salvaged and stockpiled under Section 202.

733.02 Materials. Topsoil shall be stockpiled and salvaged under Section 202.

733.03 Construction Methods. The placement of topsoil shall conform to the requirements of Section 732. After placement, the Contractor shall refertilize the topsoil in accordance with Subsection 734.03 (a) and (b)(1). Refertilization shall occur a minimum of six months after the initial seeding.

SECTION 734 SEEDING

734.01 Description. This work consists of furnishing and placing seed and soil supplements.

MATERIALS.

734.02 Water. Water shall conform to the requirements of Section 803.

734.03 Soil Supplements.

(a) Limestone shall be ground agricultural limestone and shall contain not less than 85% calcium and magnesium carbonates. Dolomitic lime or magnesium lime shall contain at least 10% magnesium oxide. The limestone shall be ground to meet the following gradation:

<i>Sieve Size</i>	<i>Percent Passing</i>
No. 10 (2.00 mm)	100
No. 20 (850 µm)	90
No. 100 (150 µm)	50

(b) Fertilizer shall conform to the following mix requirements:

(1) *Permanent Grass Seeding - Dry Ground, Wet Ground, and Subdivisions; and Temporary Grass Seeding - Dry Ground.*

- a. 70 lb/ac (78 kg/ha) nitrogen (N); 50% by weight of the nitrogen content shall be available from ureaformaldehyde.
- b. 42 lb/ac (47 kg/ha) available phosphate; phosphorous pentoxide (P₂O₅) shall be the sum of the water soluble and the citrato-soluble phosphate.
- c. 28 lb/ac (31 kg/ha) water soluble potash; potassium oxide (K₂O)

(2) *Permanent Crown Vetch Seeding.*

- a. 152 lb/ac (170 kg/ha) nitrogen (N), 100% by weight of the nitrogen content shall be available from ureaformaldehyde.
- b. 100 lb/ac (112 kg/ha) available phosphate; phosphorous pentoxide (P₂O₅) shall be the sum of the water soluble and the citrato-soluble phosphate.
- c. 100 lb/ac (112 kg/ha) water soluble potash; potassium oxide (K₂O)

(c) Commercial fertilizer shall be furnished in containers plainly marked with the chemical analysis of the product or, if provided in bulk, a certificate guaranteeing the fertilizer analysis must

- accompany each delivery to the Project. No fertilizer shall be used which has not been marketed in accordance with the State and Federal laws.
- (d) The ureaformaldehyde specified above shall meet the following requirements:
 - (1) The water insoluble nitrogen shall be at least 60% of the total nitrogen.
 - (2) The activity index of the water insoluble nitrogen shall be either:
 - a. not less than 40% by the Association of Official Analytical Chemists International (AOAC International) method for ureaformaldehyde products, or
 - b. not less than 50% by the AOAC International alkaline permanganate method, or
 - c. 80% by the AOAC International neutral permanganate method.
 - (e) Wood cellulose fiber shall be a processed wood product having uniform fiber characteristics which remains in uniform suspension in water under agitation and blends with seed, fertilizer, and other additives to form a homogeneous slurry.
The fiber shall perform satisfactorily in hydraulic seeding equipment without clogging or damaging the system. The slurry shall contain a green dye that provides easy visual inspection for uniformity of application.

734.04 Grass and Agricultural Seeds.

- (a) *Seeds.* All seed shall be fresh, clean, from new crop seed, and delivered to the site in original unopened packages in accordance with the Delaware Code and respective State laws.
- (b) *Seed Inspection.*
 - (1) Blended seed lots shall be mixed in the presence of an authorized representative of the Department. All such blended seed shall also display an official Department's inspection tag which has been sewn into or otherwise attached to the bag.
No seed shall be used after the expiration date placed on the official Department's inspection tag by an authorized representative of the Department.
 - (2) With all single seed lots, the Contractor shall furnish to the Project inspector two copies of the certified mill analysis for the seed to be used. The Project inspector will compare the mill analysis with the mill tags sewn into the bags of seed for lot number, guaranteed analysis, and certification date.
If the mill tags and mill analysis data are identical and meet the Project requirements, single seed lots can be used on the basis of verification by the Project inspector.
If the entire bag of a single seed lot is not used, the weight of the seed used from the bag shall be so noted on the mill tag which shall be left intact on the bag. In addition, the Project inspector will also include the Contract number of the Project and the date on which the seed was used, and so verify the above with its signature on the mill tag. Partial bags which have the above information noted on the mill tag will be accepted for use on Department projects.
No seed shall be used which has a dated mill analysis or mill tag older than nine months.
- (c) *Permanent and Temporary Seeding.* The Seeding Chart on the following pages shall be used for the following specified seeding:
 - Permanent Grass Seeding - Dry Ground,*
 - Permanent Crown Vetch Seeding,*
 - Permanent Grass Seeding - Wet Ground,*
 - Permanent Grass Seeding - Subdivisions,*
 - Temporary Grass Seeding - Dry Ground, and*

JP COURTS 3/17
State Project #MC0213000002

734

SEEDING

Temporary Grass Seeding - Wet Ground.

Seeding Chart					Modification Factors for Seeding Rate Pounds per acre (kilograms per hectare)			Modifications Factors for Seeding Periods	
Species	Max % Weed	Min % Purity	Min % Germination	Seeding Rate lb/ac (kg/ha)	Seeding Period A (2/16-4/15)	Seeding Period B (4/16-8/15)	Seeding Period C (8/16-2/15)	North District	Central and South Districts
Permanent Grass Seeding – Dry Ground									
Hard Fescue blend (<i>Festuca trachyphylla</i>)	0.15	98	85	100 (113.0)	Add 5lb/ac (6.0kg/ha) (<i>Agrostis Alba</i>) + 65lb-ac (73.0kg/ha)	Add 4lb/ac (6.0 kg/ha) Korean or Kobe Lespedeza (<i>Lespedeza stipulacea</i>)	Add 5lb/ac (6.0 kg/ha) Redtop (<i>Agrostis alba</i>) +65lb-ac (73.0kg/ha)		Add 3lb/ac (4.0 kg/ha) Weeping Lovegrass (<i>Eragrostis cuvula</i>) during Seeding Period B
Perennial Ryegrass (<i>Lolium perenne</i>)	0.15	98	90	10 (12.0)	Winter Rye (<i>Secale cereal</i>) From 2/16 – 3/1		Winter Rye (<i>Secale cereal</i>) From 10/15 – 2/15		
Total Seed Quantity lb/ac (kg/ha)				110 (125.0)	180 (204.0)	114 (130.0)	180 (204.0)		117 (134.0)
Permanent Crown Vetch Seeding									
Crown Vetch (<i>Coronilla varia</i>)	0.35	99	70	30 (34.0)	Add 65 lb/ac (73.0 kg/ha) Winter Rye (<i>Secale cereal</i>) from 2/16 – 3/1	Add 4lb/ac (6.0 kg/ha) Korean or Kobe Lespedeza (<i>Lespedeza stipulacea</i>)	Add 5lb/ac (6.0 kg/ha) Redtop (<i>Agrostis alba</i>) +65lb-ac (73.0kg/ha)		
Annual Ryegrass (<i>Lolium multiflorum</i>)	0.15	95	90	22 (25.0)			Winter Rye (<i>Secale cereal</i>) From 10/15 – 2/15		
Total Seed Quantity lb/ac (kg/ha)				52 (59.0)	117 (132.0)	56 (64.0)	122 (138.0)		
Permanent Grass Seeding – Wet Ground									
Redtop (<i>Agrostis alba</i>)	0.75	95	90	40 (45.0)	Add 65 lb/ac (73.0 kg/ha) Winter Rye (<i>Secale cereal</i>) from 2/16 – 3/1		Add 65 lb/ac (73.0 kg/ha) Winter Rye (<i>Secale cereal</i>) from 10/15-2/15		
Creeping Bentgrass (<i>Agrostis palustris</i>)	0.75	98	90	25 (28.0)					
Sheep Fescue (<i>Festuca ovina</i>)	0.50	98	85	35 (40.0)					
Rough Stalked Bluegrass (<i>Poa trivialis</i>)	0.50	98	80	25 (28.0)					
Total Seed Quantity lb/ac (kg/ha)				125 (141.0)	190 (214.0)		190 (214.0)		
Permanent Grass Seeding – Subdivisions									
Hard Fescue Blend (<i>Festuca trachyphylla</i>)	0.15	98	85	100 (113.0)				Add 50lb/ac (56.0kg/ha)	
Perennial Ryegrass (<i>Lolium perenne</i>)	0.15	98	90	10 (12.0)				Kentucky Bluegrass (<i>Poa pratensis</i>) during seeding periods A, B, C	
Total Seed Quantity lb/ac (kg/ha)				110 (125.0)				160 (181.0)	

JP COURTS 3/17
State Project #MC0213000002

SEEDING

734

Seeding Chart					Modification Factors for Seeding Rate Pounds per acre (kilograms per hectare)			Modifications Factors for Seeding Periods	
Species	Max % Weed	Min % Purity	Min % Germination	Seeding Rate lb/ac (kg/ha)	Seeding Period A (2/16-4/15)	Seeding Period B (4/16-8/15)	Seeding Period C (8/16-2/15)	North District	Central and South Districts
Temporary Grass Seeding – Dry Ground									
Annual Ryegrass (<u>Lolium multiflorum</u>)	0.15	95	90	40 (45.0)	Add 65 lb/ac (73.0 kg/ha) Winter Rye (<u>Secale cereal</u>) from 2/16 – 3/1		Add 65 lb/ac (73.0 kg/ha) Winter Rye (<u>Secale cereal</u>) from 10/15 – 2/15		
Total Seed Quantity lb/ac (kg/ha)				40 (45.0)	105 (118.0)		105 (118.0)		
Temporary Grass Seeding – Wet Ground									
Annual Barnyard grass/Duck Millet (<u>Echinochloa spp</u>)	1.0	90	90	40 (45.0)	Add 65 lb/ac (73.0 kg/ha) Winter Rye (<u>Secale cereal</u>) from 2/16 – 3/1		Add 65 lb/ac (73.0 kg/ha) Winter Rye (<u>Secale cereal</u>) from 10/15 – 2/15		
Total Seed Quantity lb/ac (kg/ha)				40 (45.0)	105 (118.0)		105 (118.0)		

Seeding Chart Notes

- 1 The seed shall be a blend of certified Bluegrass varieties with no one variety representing more than 25% by weight of the total, at least one variety must be a Mid-Atlantic ecotype.
- 2 Combination of improved certified varieties with SR-3000 representing a minimum of 50% by weight of the total.
- 3 Germination shall include a total of 60% minimum quick germination or normal sprouts plus a minimum of 20% hard seed.
- 4 *Permanent Seeding - Wet Ground* should be used on saturated or seasonally flooded areas as dictated by defined wetland limits on the Plans.
- 5 Festuca ovina shall be an improved variety of Sheep Fescue as approved by the Department. Selection should be based on performance within the Mid-Atlantic region as determined by the most current National Turfgrass Evaluation Program Progress Report.
- 6 Wet, bare ground, leaf litter covered or partially vegetated retention ponds, traps, or basins, or all intermittently flooded sites in general may be seeded with *Temporary Seeding - Wet Ground*. No wood fiber mulch shall be added to the hydroseeder. In addition, no mulching item should be included with this seeding. Unless indicated on the Plans, Echinochloa spp. is equivalent to E. muricata, E. crusgalli, or E. walteri. No fertilizer or limestone shall be applied with this seeding.
- 7 No Johnsongrass seed (Sorghum halapense) or Canada Thistle (Cirsium arvense) shall be allowed under the maximum allowable percentage of weed seeds and in accordance with Section 1, Chapter 24, Title 3 of the Delaware Code.
- 8 Add 3 lb/ac (4.0 kg/ha) Weeping Lovegrass on all slopes 1:3 (vertical to horizontal) or steeper and greater than 10" (250 mm) vertically in height throughout the Central and South Districts during all seeding periods to *Permanent Grass Seeding - Dry Ground*, *Permanent Crown Vetch Seeding*, and *Permanent Grass Seeding - Wet Ground*.

734.05 Seed Inoculant. The inoculant for *Permanent Crown Vetch Seeding* shall be a pure culture of nitrogen fixing bacteria selected for maximum vitality and for the ability to transform nitrogen from the air into soluble nitrates and deposit them in the soil. Inoculant shall consist of purely bred cultures and shall not be used later than the date indicated on the container. Four times the normal amount of

inoculant as indicated on the packaging shall be used for wet application. The inoculant shall be kept as cool as possible until used. Since temperatures above 75 to 80 °F (24 to 27 °C) weaken the bacteria, the Contractor shall take every precaution possible while handling the inoculant.

CONSTRUCTION METHODS.

734.06 General. This work shall consist of preparing the ground and furnishing and placing all lime, fertilizer, and seed on the areas indicated on the Plans and as specified by the Engineer. This work shall include, in addition to the lime, fertilizer, and seed, the specified quantity of inoculant and mulch required in the seeding slurry when placing crown vetch. The Engineer reserves the right to stop seeding operations whenever conditions are determined to be unfavorable. All materials used on this Contract shall be obtained by the Contractor from a dealer or manufacturer whose product is shown by analysis to fulfill the guarantee claimed by the producers.

Permanent Seeding - Wet Ground and Temporary Grass Seeding - Wet Ground, where specified for dry application by the kilogram, shall be seeded through a hand spinner type spreader. Areas specified for this method of application shall be remote sites not otherwise accessible with wet application equipment.

734.07 Seeding Slopes Flatter than 1:3 (vertical to horizontal).

(a) *General.* All topsoil placement and grading where specified shall be completed before seeding.

This shall apply to the following specified seeding:

*Permanent Grass Seeding - Dry Ground,
Permanent Grass Seeding - Wet Ground,
Permanent Grass Seeding - Subdivisions,
Temporary Grass Seeding - Dry Ground, and
Temporary Grass Seeding - Wet Ground.*

(b) *Seedbed Preparation for Dry Ground Areas with Topsoil.* The area to be seeded shall be thoroughly loosened to a depth of not less than 6" (150 mm). The topsoil shall be original surface friable loam topsoil conforming to Section 732. The topsoil shall be of uniform quality, free from gravel and stones retained on a 2" (50 mm) sieve, heavy clay, frozen clods, lumps, roots, sticks, and foreign materials harmful to plant growth, such as 2" (50 mm) or larger fragments of hot-mix, concrete, and surface treatment. If shaped to the prescribed grade, the seedbed shall be considered satisfactory and shall require no further work.

However, when the area to be seeded is partially sodded, barren, weedy, or packed and hard, any grass and weeds shall first be cut or otherwise satisfactorily removed, and the soil shall then be scarified or otherwise loosened to a depth of not less than 6" (150 mm). Clods and lumps shall be broken. Rubbish, rocks, fragments 2" (50 mm) or larger of hot-mix, concrete, surface treatment, and other extraneous matter shall be removed clear of the seeding site.

No seedbed preparation will be required for *Permanent Grass Seeding - Wet Ground, Temporary Grass Seeding - Wet Ground, or Temporary Grass Seeding - Dry Ground.*

(c) *Quantities of Material.* The quantity of limestone as specified according to Subsection 734.03 (a) shall be applied at the rate of 3000 lb/ac (3400 kg/ha). Fertilizer, wood cellulose fiber, and other required seeding agents shall be applied in accordance with Subsection 734.03.

The quantity of seed applied shall be in accordance with the Seeding Chart under Subsection 734.04.

(d) *Application Equipment.* All wet application equipment shall have a tank equipped with an agitation system capable of keeping all of the solids in a state of complete suspension at all times

during the seeding operation. All dry application equipment to include drop or hopper type spinner spreaders and drills shall require that all seed be blended by the seed supplier and so certified prior to dumping or loading to reduce seed segregation.

- (e) *Wet Application of Lime, Fertilizer, Wood Cellulose Fiber, Seed, Inoculant, and Any Coloring or Binding Agents.* The Contractor shall apply all ingredients specified for the seeding operations described in Subsection 734.07 (a) according to both manufacturer's equipment and material specifications and as set forth according to individual seeding requirements as specified under Subsection 734.03.

Permanent Grass Seeding - Dry Ground shall be used in accordance with this Section on all areas not delineated or defined as wetlands that are flatter than 1:3 (vertical to horizontal) in grade and on areas behind guardrail to the top or breakpoint of slope. The only exception shall apply to slopes 1:3 (vertical to horizontal) or steeper in urban areas as described under Subsection 734.08. In these areas, topsoil shall be required at a depth of 63 (150 mm) in accordance with Sections 732 and 733 respectively.

Permanent Grass Seeding - Wet Ground shall be used in accordance with this Section on all areas delineated or defined as wetland on the Plans with the exception of dry fill such as stormwater pond embankments and dikes or regraded areas comprised of fill above the original wetland profile. Areas stripped under Section 202 and specified for *Permanent Grass Seeding - Wet Ground* shall be covered with 63 (150 mm) of topsoil in accordance with Section 733. Permanent dry fill areas above the original wetland profile, as described above, shall be seeded under *Permanent Grass Seeding - Dry Ground*.

In stormwater management ponds with permanent pools *Permanent Grass Seeding - Wet Ground* shall be used on the slope between the permanent pool water level and the contour line 22 (0.6 m) above the water level. In ponds without permanent pools, this seeding mix shall be applied from the pond bottom to the elevation reached during flood routing 13 (25 mm) of runoff (water quality extended detention).

Permanent Grass Seeding - Subdivisions shall be used in accordance with this Section on all areas defined as legal subdivisions or residential communities where maintenance is provided by the Department from curb to curb only or is limited to the traveled way and shoulders. Areas specified for *Permanent Grass Seeding - Subdivisions* shall be topsoiled with 63 (150 mm) of approved topsoil in accordance with Section 732.

Temporary Grass Seeding - Dry Ground shall be used in accordance with Subsection 734.03 on all areas that represent dry ground areas disturbed during actual construction and/or prior to the establishment of permanent grades as determined by the Engineer in the field.

Temporary Grass Seeding - Wet Ground shall be used on wet, bare ground, leaf litter covered or partially vegetated retention ponds, traps, basins, and all intermittently flooded areas during construction.

- (f) *Dry Application of Lime, Fertilizer, and Seed.* Only the ingredients described shall be applied by dry application. All lime, fertilizer, and seed shall be applied each as a separate operation when using dry methods of application. Dry application of lime, fertilizer, and seed shall apply to all forms of seeding described under Subsection 734.07 (e).

- (g) *Responsibility for Seeded Areas.* The Contractor shall perform all seeding and mulching in accordance with this Section in the presence of the Engineer. If all work as noted is performed in complete accordance with this Section to the satisfaction of the Engineer, all seeding and mulching so approved shall be accepted.

The Department retains the right to request that the Contractor reseed any and all areas where a satisfactory stand of grass or crown vetch or both as determined by the Engineer does not exist at the time of the final inspection.

If the Engineer determines that reseeded is necessary, the Contractor shall begin reseeded within five working days of an oral or written request from the Engineer. at triple the normal rate of inoculant in the presence of the Project inspector. The inoculant and crown vetch seed must be mixed with an approved wetting or bonding agent.

- (g) *Responsibility for Seeded Areas.* The responsibilities for seeded areas shall conform to the requirements of Subsection 734.07 (g).

SECTION 735 MULCHING

735.01 Description. This work consists of furnishing, placing, and anchoring mulch over seeded areas.

735.02 Materials.

Small Grain Straw. Straw for mulching shall be from oats, wheat, rye, or other approved grain crops that are free from noxious weeds, mold, or other objectionable material. Straw mulch shall be in an air-dry condition and shall be suitable for placing with an approved mechanical blower.

735.03 Construction Methods.

Small Grain Straw. Straw mulching shall be used on all slopes flatter than 1:3 (vertical to horizontal) with the exception of slopes or sites not accessible to tracking or crimping tools and equipment. In these situations, straw-coconut fiber blankets or bonded fiber matrix shall be used.

Small grain straw shall be uniformly and evenly applied immediately after seeding has been completed.

An approved mechanical blower shall be used to apply the straw. Straw mulch applied by blowers shall provide a loose depth of not less than 1/2 nor more than 2" (13 nor more than 50 mm). Ninety-five percent of the blown and shredded straw mulch shall be 6" (150 mm) or more in length when in place.

Straw mulch shall be applied at the rate of 4000 lb/ac (4500 kg/ha) and secured by one of the following methods:

- (1) *Crimping Method.* This method of incorporating the straw into the ground shall be accomplished with the use of crimping device that produces horizontally oriented indentation. Straw mulch shall be incorporated into the soil to a minimum depth of 2" (50 mm). The crimping device shall be approved by the Engineer.
- (2) *Tracking Method.* This method may be used on all sites mulched with straw and shall involve the use of steel-cleat track-type equipment driving up and down the slopes producing horizontally oriented indentations with the cleats. Cleats shall be capable of incorporating the straw mulch into the soil to a minimum depth of 1 1/2" (40 mm). The equipment used and the method of tracking shall be approved by the Engineer.

SECTION 736 SODDING

736.01 Description. This work consists of preparing the ground area, and furnishing and placing approved sod.

MATERIALS.

736.02 Sod. Sod shall be well rooted from high quality seed of known origin and native to the locality of the work. The Department reserves the right to visit the proposed sod source prior to the granting of a source approval. Sod shall be stripped, delivered, and laid within a period of 36 hours. Sod stripped and delivered but not laid within this period shall be reinspected and approved by the Engineer prior to use.

If Fine Fescue-Bluegrass sod is used, it shall contain the following percentages by weight in the blend:

Creeping Red Fescue (<i>Festuca rubra</i> L. subsp. <i>Rubra</i>)	10%
Chewing Fescue (<i>Festuca rubra</i> L. subsp. <i>commutata</i> Gavd.)	20%
Hard Fescue (<i>Festuca longifolia</i> Thuill.)	55%
Kentucky Bluegrass (<i>Poa pratensis</i> L.)	15%

The varietal makeup of the Fine Fescue-Bluegrass sod must be submitted to the Engineer for approval prior to the actual cutting and lifting of the sod.

Sod shall be free of objectionable grassy and broadleaf weeds. Sod shall be considered free of such weeds if less than five such plants are found per 100 ft² (10 m²) of area. Sod shall not be acceptable if it contains any of the following weeds: common bermudagrass (wiregrass), quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canadian thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, or bromegrass.

Sod shall be reasonably free of thatch, diseases, nematodes, and soil-borne insects. All sod must display the official State Certification tags of the state from which the sod originated. The same shall apply to all sod shipped intra-state with prior inspection and tagging through the Delaware State Department of Agriculture.

736.03 Water. Water shall conform to the requirements of Section 803.

CONSTRUCTION METHODS.

736.04 Cutting Sod. Before stripping, sod shall be mowed uniformly at a height of 1 to 2 1/2" (25 to 65 mm). Sod shall be machine cut at a uniform soil thickness of 5/8 ± 1/4" (16 ± 6 mm), at the time of cutting. Measurement for thickness shall exclude top growth and thatch. The sod pad size shall be cut to a minimum uniform width of 12" (300 mm) and a minimum length of 12" (300 mm).

736.05 Placing. Sod shall be placed only when the soil is moist and favorable to growth. Sod shall not be placed between November 1 and April 1, unless weather and soil conditions are considered favorable and permission is granted.

736.06 Preparation of Grade. The area to be sodded shall be shaped and finished to the lines and grades indicated on the Plans, and the surface loosened prior to placing the sod. The Contractor shall water the slope before the sod is placed.

JP COURTS 3/17

State Project #MC0213000002

736.07 Laying the Sod. The sod shall be placed on the prepared surface with the edges in close contact. Each strip or section of sod shall be fitted and tamped into place with hand tampers of not less than 100 in² (64 000 mm²) in area.

After slopes of either cuts or fills have been shaped to conform to the finished grade and crosssection shown on the Plans, the shoulders and toes of the slope shall be rounded off to a 5' (1.5 m) radius, or as otherwise indicated in the Plans.

On all slopes, sod shall be laid with the long edges parallel to the contour starting at the bottom of the slope. Successive strips shall be neatly matched, and all joints staggered or broken. When placing sod in drainage ditches, the length of the strip shall be laid parallel to the direction of the flow of the water. Where the sod may be displaced during sodding operations, the workers, when replacing it, shall work from ladders or treated planks to prevent further displacement.

Each strip or section of sod placed on slopes 1:2 (vertical to horizontal) and steeper, and surface drainage V-shaped or flat bottom ditches or gutters, shall be staked securely with at least two stakes or pins spaced not more than 24" (600 mm) apart with the flat side against the slope. Stakes shall either be wood wedges or T-shaped wire pins. Wood wedges shall be ½ by 1 by 63 (13 by 25 by 150 mm) to ½ by 1 by 12" (13 by 25 by 300 mm), as required by soil conditions, and driven so that the last 1" (25 mm) remains above the top of the sod. T-shaped wire pins shall be machine bent from 15" (380 mm) pieces of 8 gage (4.1 mm) low carbon bright steel with a 8" (200 mm) leg, a 4" (100 mm) head, and a 1" (25 mm) secondary drive and driven flush with the top of the sod.

When sodding adjacent to a sidewalk, curb, pavement, or retaining walls, sufficient allowance shall be made in grading for the thickness of the sod, so that when placed, the sod shall be flush with the tops of such structures. The sod shall be tamped to ensure tight joints and a smooth level surface. As the top of the slope is reached, the sod shall be trimmed to a line placed at a fixed distance from the break of the bank and along the entire length of the cut or fill. The top of the bank shall have been previously graded, so that the sod, when applied, comes flush with the average level of the top of the bank. All surfaces shall be uniform in appearance and reasonably true to line and grade.

The Contractor shall water the sod immediately after placement to a depth sufficient so that the underside of the new sod pads and soil immediately below the sod are thoroughly wet. The sod shall be kept moist until growth is established. All sod in which shrinking, burning, or turning brown occurs shall be rejected, removed, and replaced.

A satisfactory stand of grass from sod, as determined by the Engineer, shall be required. To be acceptable, a stand of grass from sod must display an even flush of growth and show evidence of soil surface contact, minimal undermining, and minimal erosion.

SECTION 748 PAVEMENT MARKINGS

748.01 Description. This work consists of supplying and installing pavement markings on the individual lifts of pavement material and the final surface of the roadway.

748.02 Definitions. There shall be two types of pavement markings as described below:

- (1) *Temporary Markings.* Temporary markings, which replace those removed by milling or planing of pavement, are placed on individual sublifts of paving materials or on final travel surfaces, and which are kept in service for less than four weeks. Temporary markings shall be applied as specified in the Traffic Control Manual.
- (2) *Permanent Markings.* Permanent markings are usually placed on the final travel surface. Permanent markings shall always be applied in accordance with the MUTCD.

Any of the two types of markings may be used in the following applications except as limited by the MUTCD.

- (1) *Lane Line.* Lines of marking material placed between lanes of traffic.
- (2) *Edge Line.* Lines of marking material placed on the right hand side of a travel lane with two way traffic or both sides of a traveled way having one way traffic.
- (3) *Center Line.* Lines of marking material placed between lanes of traffic traveling in opposite directions.
- (4) *Detour Markings.* Markings which are placed to cause or require traffic to move from the normal or previous travel path. All detour markings shall be installed using standard marking patterns as specified in the MUTCD.
- (5) *No Passing Zones.* Any centerlines between opposing directions as on a multilane highway shall be applied in accordance with the MUTCD, or as directed by the Engineer, for all temporary or permanent markings.

MATERIALS.

748.03 Approved Materials. The Department periodically conducts tests of various pavement marking materials to determine which materials are suitable for use on Delaware roads. A list of approved materials is available from the Engineer. There is no approved list of materials for temporary paint. The paint used for temporary marking need only be paint intended for use on roadway materials and retain sufficient amounts of beads to remain reflective.

748.04 Alkyd Type Thermoplastic Material. The thermoplastic material that is available in white and highway yellow shall be homogeneously composed of pigment, filter, resins, and glass reflectorizing spheres. It shall melt uniformly with no evidence of skins or unmelted particles. It shall not deteriorate on contact with sodium chloride, calcium chloride, or other de-icing chemicals or because of oil content of paving materials or oil drippings. It shall be tested in accordance with AASHTO T 250 and M 249 or with the appropriate method in FED-STD-141C or ASTM designation.

The thermoplastic material shall be suitable for application immediately after compaction of the final lift of asphaltic concrete. The thermoplastic shall be neither permanently discolored nor softened by contact with hot-mix bituminous concrete.

The white thermoplastic material shall not exceed a yellowness index of 0.15.

The yellow color shall reasonably match color chip No. 13538 of FED-STD-595B. The test shall be performed at 77 °F (25 °C).

- (1) *Alkyd Binder.* The binder shall consist of mixture of synthetic resins, at least one of which is solid at room temperature, and high boiling point plasticizer. At least one-third of the binder composition shall be solid maleic-modified glycerol ester resin and shall be no less than 18% by weight of the entire material formulation. The binder shall not contain petroleum based hydrocarbon resins.
- (2) *Composition.* The pigment, glass beads, and filler shall be uniformly dispersed in the resin. The material shall be free from all skins, dirt, and foreign materials or objects and shall comply with the following requirements.

Composition (percent by weight)

<i>Component</i>	<i>White</i>	<i>Yellow</i>	<i>Black</i>
Alkyd Binder	18.0 minimum	18.0 minimum	18.0 minimum
Glass Beads	30 – 40	30 – 40	0.00 maximum
Titanium Dioxide	10.0 minimum	- - -	0.0 maximum
Calcium Carbonate and Inert Fillers	42.0 maximum	50.0 maximum	52.0 maximum
Yellow Pigment	52.0 maximum	50.0 maximum See Note (a)	- - -

Note (a): Amount of yellow pigment, calcium carbonate, and inert fillers shall be at the option of the manufacturer, providing all other requirements of this specification are met.

- (3) *Physical Characteristics.*
 - (a) *Specific Gravity.* The specific gravity of the thermoplastic traffic line material shall not exceed 2.15.
 - (b) *Storage Life.* Any unused material which does not conform to the requirements of the specification for a period of one year shall be replaced by the manufacturer at no cost to the Department.
 - (c) *Set Time.* When applied at a temperature range of 412 ± 12 °F (211 ± 7 °C) and at a thickness of 0.0625 to 0.1253 (1.5 to 3.0 mm), the material shall set to bear traffic in not more than two minutes when the air temperature at 50 ± 4 °F (10 ± 2 °C), and not more than ten minutes when the air temperature is 90 ± 4 °F (32 ± 2 °C).
 - (d) *Color.** Daylight reflectance at 45 degrees - 0 Degrees:

White:	75%
Yellow:	45%
 - (e) *Bond Strength.** The bond strength to the pavement shall exceed 1,800 psi (1.24 MPa).
 - (f) *Resistance to Cracking at Low Temperature.** Applied to concrete blocks, and cooled to 201 ± 4 °F (94 ± 2 °C), the material shall show no cracks.
 - (g) *Impact Resistance.** The impact resistance shall be a minimum of 10 in lb (1.13 N m) upon test specimens.
 - (h) *Softening Point.** Tested in accordance with ASTM D 36, the materials shall have a softening point of 216 ± 14 °F (102 ± 8 °C).
 - (i) *Flowability.** Tested for flowability, the white thermoplastic shall have a maximum residue of 18% and the yellow thermoplastic shall have a maximum residue of 21%.

- (j) *Flowability Extended Heating.** After extending the heat period by four hours and 30 minutes, when tested for flowability, the thermoplastic shall have a maximum residue of 28%.
- * For the tests (d) through (j), the thermoplastic material shall be heated under agitation for four hours plus or minus five minutes at 424 ± 4 °F (218 ± 2 °C) prior to the start of the test.

748.05 Glass Spheres.

- (a) *Pre-Mixed in the Material.* The glass spheres shall be uncoated and shall conform to the requirements of AASHTO M 247, Type 1.
- (b) *Surface Applied.* The glass spheres shall conform to the requirements of AASHTO M 247, Type 1, except that the beads must be moisture resistant coated to conform to the requirements of procedure 4.4.2 (AASHTO M 247) and a maximum of 5% shall pass the No. 80 sieve (180 µm) screen. Glass spheres shall have a minimum of 70% true spheres on each sieve and 80% true spheres overall.

748.06 Packaging and Marking. The thermoplastic material shall be packaged in suitable containers to which it will not adhere during shipment and storage. The container of thermoplastic material shall weigh approximately 50 lb (23 kg). Each container shall designate the color, binder (alkyd), spray or extrude, user information, manufacturer's name and address, batch number, and date of manufacture. Each batch manufactured shall have its own separate number. The label shall warn the user that the material must be heated in the range of 400 to 440 °F (204 to 227 °C).

748.07 Vendor Qualification. In order to be eligible to supply the required pavement marking materials, evidence of three years successful services for alkyd-based materials in transverse and/or symbol applications shall be provided in writing. Successful service shall be evidenced by color stability, retention of retroreflective properties, crack resistance, and lack of softening or permanent discoloration due to exposure to oil and grease drippings for the required three year period. The documentation must be from three projects in areas with similar climactic conditions within the United States.

748.08 Equipment. The equipment used to apply pavement markings shall conform to the following requirements:

- (1) *Paint Equipment.*
- (a) Shall be able to apply double centerlines simultaneously (except temporary markings may be applied separately).
 - (b) Shall be capable of applying paint and glass beads to pavement at same time, leaving no more than 2" (50 mm) of painted line without glass beads at the beginning or end of a line.
 - (c) Shall be capable of hand gun operation for applying special markings. (This may be a separate piece of equipment.)
- (2) *Truck Mounted Paint Equipment.*
- (a) Shall have steerable gun carriages.
 - (b) Must be able to apply double centerlines simultaneously.
 - (c) Shall be capable of pneumatically applying glass beads 1" (25 mm) behind the spray pattern of the paint gun.

- (d) Shall have an automatic, electrically controlled skipline mechanism capable of retracing the existing 10' (3 m) stripe and 30' (9 m) skip or applying a new 10' (3 m) stripe and 30' (9 m) skip.
- (3) *Thermoplastic Equipment.*
 - (a) Shall provide for constant mixing and agitation of the material.
 - (b) Shall apply the material to the road surface in a molten state at the temperature specified in Subsection 748.08 (c)(1) by screed extrusion means.
 - (c) Shall apply glass beads instantaneously upon the installed line to ensure adhesion.

748.09 Application.

- (a) *General.* The Contractor shall protect all pavement markings until track free. In the event any vehicle should cross wet pavement markings, the damaged markings shall be removed by sand blasting, heat, or other methods acceptable to the Department and replaced. All necessary markings shall be installed before the end of the workday. Whenever work is interrupted by weather, the markings shall be installed as soon as possible. Due to safety requirements, this Section shall overrule Subsection 101.39 which prevents work on holidays. The Contractor shall furnish to the Department the applicable warranty for the material to be installed to ensure proper performance. Thermoplastic pavement markings shall not be applied on portland cement concrete and other concrete surfaces.
- (b) *Paint.*
 - (1) This specification is to cover the application of pigmented binder (white and yellow) and optical glass spheres system to the highway surface with specialized equipment.
 - (2) The reflective surface shall be obtained by applying optical glass spheres at the rate of 5 lb/gal (0.6 kg/L) of paint onto and into the pigmented binder in one operation as specified under this Subsection. The number of gallons (liters) of paint used and the number of pounds (kilograms) of beads used shall be determined. Rate application will be calculated by dividing the gallons (liters) of paint used for the day into the number of pounds (kilograms) of beads used for the day, and the result should be 5 lb/gal (0.60 kg/L) within $\pm 2\%$. If the result does not meet this limit, the day's work shall be redone.
 - (3) Pigmented binder (paint), white or yellow, shall be applied by the Contractor according to the paint manufacturer's recommendations. The paint shall only be applied when ambient air temperature is 40 °F (4 °C) or higher. The wet film thickness shall be 0.015 ± 0.0013 (0.38 \pm 0.03 mm).
- (c) *Thermoplastic Alkyd Type Material.*
 - (1) *Application.* For optimum adhesion, the thermoplastic material shall be installed in a molten state at a temperature between 400 to 425 °F (204 to 218 °C) on a clean, dry, and solvent free surface. The Contractor shall clean off pavement surface dirt and grease where necessary by approved removal methods. Thermoplastic pavement marking materials shall not be applied when pavement temperatures are below 50 °F (10 °C) or when the surface of the pavement shows evident moisture.

A primer sealer if recommended by the manufacturer of the thermoplastic material shall be applied prior to the installation of thermoplastic material on the pavement if required by the Department. The primer shall be void of solvent and water prior to the installation of thermoplastic material.

The material shall readily apply to the pavement from either manual or self propelled application equipment by the screed/extrusion method wherein one side of the

shaping die is the pavement and the other three sides are contained by a part of suitable equipment for heating and controlling the flow of material.

The material, when formed into traffic stripes, must be readily renewable by placing an overlay of new material directly upon any type of old thermoplastic line, provided that the initial material was properly bonded, or on worn paint line showing considerable pavement exposure. Such new material shall bond itself to the old line in such a manner that no splitting or separation takes place.

The application equipment shall conform to the requirements of this Subsection and be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be accomplished in a true arc. The heating kettle and application equipment shall conform to the requirements of the National Fire Underwriters of the National Fire Protection Association and of the State.

The equipment used to install hot applied thermoplastic material by contract under

this Section shall be constructed to provide continuous uniform heating to temperatures exceeding 400 °F (204 °C), mixing, and agitation of the material. The conveying parts of the equipment between the main material reservoir and the line dispensing device shall prevent accumulation and clogging. All parts of the equipment which come in contact with the material shall be constructed for easy accessibility for cleaning and maintenance. The equipment shall operate so that all mixing and conveying parts, including the line dispensing aprons or similar appliances which the dispenser overruns, will not be permitted. The equipment shall provide for traffic marking application of varying widths in even multiples of 4 or 6" (100 or 150 mm).

Glass spheres shall be applied to the surface of the completed stripe by drop-on or pressure spray methods at an approximate uniform rate of 0.100 lb of glass spheres every square foot (0.49 kg of glass spheres every square meter) [0.033 lb/ft of 4" (50 g/m of 100 mm)] from automatic dispenser attached to the striping machine so that the glass spheres are dispensed closely behind the installed line. The glass sphere dispenser shall be equipped with an automatic cut-off control synchronized with the cut-off of the thermoplastic material.

- (2) *Patterns.* The thickness measurement prior to application of drop-on glass beads shall be 0.125" (3.18 mm) for crosswalks and stop bars and 0.090" (2.28 mm) for lanelines, centerlines, and edgelines.

Calibration shall be done by placing black tapes, film, or metal plates of known and uniform thickness in the area to be striped. Once the striper has passed over, the sample is removed by making sharp cuts with a knife and measurement of the stripe plus base are made with a micrometer or vernier calipers with a proper correction for the base.

For longitudinal lines, these thickness checks shall be made every 1,600' (500 m) or more frequently at the judgment of the Engineer. For symbols and intersection markings, the frequency of checking shall be at the option of the Engineer. These thicknesses shall be considered as the average of two or more measurements made in a 3' (1 m) distance.

Longitudinal lines shall be offset at least 2" (50 mm) from construction joints and 2" (50 mm) to the inside of shoulder breaks of pavement. Openings 6" (150 mm) in length shall be provided at 20' (6 m) intervals in edgelines placed on the inside of super elevated curves to prevent ponding of water on the pavement surface.

The finished lines shall have well defined edges.

The typical skip pattern shall be based on a 40' (12 m) cycle made up of a 10' (3 m) painted surface and a 30' (9 m) space.

(d) *Reflectivity for Paint and Alkyd Type Thermoplastic Material.*

After satisfactory completion of all striping work and written notification from the Contractor, the Department will test the striping to ensure it has the minimum reflectivity. The testing will be completed within 30 calendar days from notification. The Contractor shall accept lower average readings derived from late testing due to the Contractor's failure to notify the Engineer. The Contractor may request that tests be conducted on completed phases or portions of the work. Approval of such a request will be at the discretion of the Engineer. Testing will be done using a Delta LTL 2000 Retrometer (30 meter geometry). Five readings will be taken per line per 1 mile (1.6 kilometer). Projects less than 1 mile (1.6 kilometer) in length will have a minimum of five readings per line.

The required minimum initial reflectivity reading in millicandellas for alkyd thermoplastic markings shall be:

White 300

Yellow 200

For alkyd thermoplastic markings below these minimums and above 125 millicandellas, payment will be reduced as described under Basis of Payment.

All markings (paint and alkyd thermoplastic) with an average reflectivity below 125 millicandellas shall be removed and replaced at the sole expense of the Contractor.

(e) *Guarantee for Alkyd Type Thermoplastic Material.*

Acceptance of this project will be contingent upon successful completion of a 180 day observation period under traffic beginning upon the satisfactory completion of all striping work required by the Contract.

During the 180 day observation period the thermoplastic Pavement Marking Material furnished and installed under this Contract shall be warranted against failure due to blistering, excessive cracking, bleeding, staining, discoloration, oil content of the pavement materials, smearing and spreading under heat, deterioration due to contact with grease deposits, oil, diesel fuel, or gasoline drippings, chipping, spalling, poor adhesion to the pavement materials, vehicular damage, and wear. Any markings that have not performed satisfactorily during the 180 day observation shall be replaced by the Contractor at no expense to the Department.

Marking replacement shall be performed in accordance with the requirements specified herein for the initial application, including but not limited to possible surface cleaning, pavement marking removal, seasonal and weather limitations, etc.

The Contractor shall replace or renew, entirely at his/her expense, the amount of pavement markings deemed by the Engineer to have failed to perform useful service during the period noted above. The replacement material installed under this guarantee shall be the same as the original material.

SECTION 760 PAVEMENT – MILLING

760.01 Description. This work consists of milling or planing existing bituminous concrete and portland cement concrete pavement.

760.02 Construction Methods. The pavement milling machine shall be one which is suitable for the use in milling and planing bituminous and portland cement concrete pavements.

Milled materials shall be reused or otherwise disposed of as specified in Subsection 106.09.

SECTION 762 SAW CUTTING PORTLAND CEMENT AND HOT-MIX, HOTLAID BITUMINOUS CONCRETE

762.01 Description. This work consists of mechanically saw cutting patch edges or tie-in joints into existing pavement.

BITUMINOUS CONCRETE

762.02 Construction Methods. The equipment used shall be a saw cutting machine capable of cutting portland cement concrete and hot-mix, hot-laid, bituminous concrete pavements. The machine shall consist of a suitable motor driven diamond blade circular cutter with control devices, mounted on a sturdy frame. The equipment shall be capable of cutting a groove in a straight line to a sufficient depth so that an even, neat joint will be cut to allow removal of material without damage to the adjacent pavement. A continuous water supply shall be supplied to the cutting element either by a water tank on the equipment or by other means. Equipment other than that specified for saw cutting may be used if the material to be cut is hot-mix, hot-laid bituminous concrete. When saw cutting portland cement concrete for removal of pavement, the depth of saw cut shall be the full depth of the pavement.

SECTION 803 WATER FOR MIXING PORTLAND CEMENT CONCRETE

Water used in mixing, curing, or other designated applications shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product. Water will be tested in accordance with AASHTO T 26. Water known to be of potable quality may be used without testing. Where the source of water is relatively shallow, the intake shall be enclosed to exclude silt, mud, grass, or other foreign materials.

The water shall conform to the following requirements:

Hydrogen ion concentrations	4.5 to 8.5 pH
Total solids	5000 ppm
Total chlorides	300 ppm
Soluble SO ₄	500 ppm
Total alkalis as Na ₂ plus 0.658K ₂ O	500 ppm
Organic content	2000 ppm
Compressive strength, minimum	90% of control
Time of setting, Vicat	±60 minutes from control and within the specifications of AASHTO M 85

SECTION 804 FINE AGGREGATE

Fine aggregate for use in portland cement concrete shall conform to the requirements of AASHTO M 6, except the grading shall be:

<i>Sieve Size</i>	<i>Percent Passing</i>
3/8" (9.5 mm)	100
No. 4 (4.75 mm)	95 - 100
No. 50 (300 µm)	5 - 30
No. 100 (150 µm)	1 - 10
No. 200 (75 µm)	0 - 4

Fineness Modulus: 2.3 to 3.1

The organic impurities requirement will be waived for fine aggregate specified for uses other than in portland cement concrete.

SECTION 805 COARSE AGGREGATE

Coarse aggregate shall conform to the requirements of AASHTO M 80 except no gravel, crushed gravel, or crushed concrete shall be used. Also, the requirements of Section 2.1, percentage of wear, Los Angeles Test, shall not be more than 45%. If air-cooled, blast-furnace slag is used, it shall weigh not less than 70 pounds per cubic foot (1.12 metric tons per cubic meter) when tested according to AASHTO T 19/T 19M.

SECTION 810 ASPHALT CEMENT

Asphalt cement shall be prepared by the refining of crude petroleum using methods conforming to industry standards. The asphalt cement shall conform to the requirements of AASHTO M 226, Table 2.

When tested by ignition, the inorganic insoluble residue content of the asphalt cement shall not exceed 0.25% by weight.

SECTION 812 PORTLAND CEMENT CONCRETE

812.01 Description. This material consists of portland cement, fine aggregate, coarse aggregate, water, and admixtures mixed in the specified proportions for the various classes of concrete.

812.02 Materials.

- (a) *Portland Cement.* Portland cement shall conform to the requirements of Section 801.
- (b) *Water.* Water shall conform to the requirements of Section 803.
- (c) *Fine Aggregate.* Fine aggregate shall conform to the requirements of Section 804.
- (d) *Coarse Aggregate.* Coarse aggregate shall conform to the requirements of Section 805.
- (e) *Gradation.* Coarse aggregate shall conform to the requirements of Section 813, No. 57.
- (f) *Air Entrainment Agent.* An air-entrainment agent conforming to the requirements of AASHTO M 154 shall be introduced into the mixer by an approved automatic dispenser.
- (g) *Chemical Admixtures.* Chemical admixtures shall conform to the requirements of AASHTO M 194 for the seven types as follows:
 - Type A - Water Reducing
 - Type B - Retarding
 - Type C - Accelerating
 - Type D - Water Reducing and Retarding
 - Type E - Water Reducing and Accelerating
 - Type F - Water Reducing, High Range
 - Type G - Water Reducing, High Range and Retarding

For concrete Classes A and D, calcium chloride or other admixtures containing detrimental amounts of chloride salts shall not be used in the concrete. The chloride content of bridge deck concrete shall not exceed 0.10% by weight of cement.

- (h) *Fly Ash.* Fly ash may be used as an additive in concrete in order to promote workability and plasticity. Fly ash shall conform to the requirements of Section 822.
- (i) *Curing Materials.* Curing materials shall be as follows:
- (1) *Liquid Membrane Compounds.* The material shall conform to the requirements of AASHTO M 148, for Type 2, Class A or B white-pigmented liquid curing compound. Acceptance for continued use will be based upon satisfactory field performance.
 - (2) *Polyethylene Sheeting.* Polyethylene sheeting shall conform to the requirements of AASHTO M 171.
 - (3) *Waterproof Paper.* Waterproof paper shall conform to the requirements of AASHTO M 171. The name of the manufacturer shall be marked or imprinted clearly on the paper for proper identification.
 - (4) *Water Cure.* The water shall conform to Section 803.
- (j) *Samples.* The source of fine aggregate, coarse aggregate, cement, additives, and admixtures shall be submitted to the Department's Materials and Research Section prior to any concreting operations in sufficient time so mix design verification may be performed.
- Coarse and fine aggregates for use in portland cement concrete mixtures will also be evaluated for potential alkali-silica reactivity using ASTM C 1260 Mortar Bar Method and may be evaluated by ASTM C 295 Petrographic Examination. Furthermore, if available, field service records of the aggregate in concrete will be evaluated. Aggregate sources determined to be reactive with cement alkali will be permitted in concrete mixtures using either low alkali (0.6% or less) cement or Type IP cement. Use of high alkali cement will be permitted with these aggregates provided one of the following options is used to modify the cement matrix:
- (1) Substitution of 35 to 50% of the portland cement with ground granulated blast furnace slag conforming to AASHTO M 302, Grade 100 or Grade 120;
 - (2) Substitution of 7 to 10% of portland cement with silica fume conforming to the requirements of AASHTO M 307; or
 - (3) A minimum 20% substitution of portland cement with fly ash conforming to Section 822; or
 - (4) Use of a lithium-based admixture at a dosage rate based upon the sodium oxide equivalent (AASHTO M 85) of the portland cement component of the concrete. The lithium dosage shall be 1 lb (1 kg) of lithium hydroxide monohydrate per 1 lb (1 kg) of sodium oxide equivalent of the portland cement, with a minimum dosage of 0.60% by weight of the portland cement. Other approved lithium compound may be used but shall be dosed in equivalents of lithium hydroxide monohydrate. All lithium salts shall be certified as non-hazardous based on the heavy metal content. Mixing shall be as per manufacturer's recommendation.
- (k) *Fiber Reinforcement.* Fiber reinforcement shall conform to the requirements of Subsection 824.02(j).

812.03 Handling and Storing Materials.

- (a) *Aggregate.* Aggregate stockpiles shall be placed on hard, clean, and well drained surfaces of acceptable materials such as portland cement concrete, or hot-mix bituminous concrete and be of sufficient thickness to withstand the loadings of construction equipment. If, at any time, the surfaces break up so as to possibly contaminate the aggregate stockpiles, the concrete operation shall be immediately stopped until such time that the surfaces may be repaired. Prior to stockpiling aggregates, the Department's Materials and Research Section shall be contacted for approval of the base surface material. Coarse and fine aggregate shall be kept separate during

transportation, handling, and storage until batched. If necessary, suitable partitions shall be constructed to prevent mixing of the fine and coarse aggregates.

Aggregate stockpiles shall be constructed in horizontal layers not exceeding 5' (1.5 m) in depth in order to avoid segregation. Segregated material shall be removed from stockpiles and disposed of or remixed to the satisfaction of the Engineer.

Fine aggregate shall be stockpiled at the batch plant a minimum of 24 hours prior to batching or longer if required until surplus water has disappeared and the material has a uniform free moisture content. Wet fine aggregate shall not be placed where it becomes mixed with material being used for batching. Suitable partitions shall be constructed to prevent mixing of the wet fine aggregate and the fine aggregate being used for batching. Batching direct from the washing plant will not be permitted.

Haul roads to the concrete plants shall be of such base as to prevent any deleterious materials from being incorporated into the stockpiles and into the concrete itself. If at any time, deleterious materials are found in the stockpiles, the concrete operation shall be immediately stopped.

- (b) *Cement.* Reclaimed cement or cement that shows evidence of hydration, such as lumps or cakes, shall not be used. All cement shall be stored in suitable weatherproof structures that protect the cement from dampness.
- (c) *Fly Ash.* Fly ash which shows evidence of hydration, such as lumps or cakes, shall not be used. All fly ash shall be stored in suitable weatherproof structures that protect the fly ash from dampness and other contamination.
- (d) *Admixtures.* Admixtures shall be stored and handled in such a manner that contamination or deterioration is prevented. Admixtures shall not be used unless thoroughly agitated to the satisfaction of the Engineer or the Engineer's agent. Partially frozen admixtures shall not be used. When the amount of admixture required to give the specified results deviates appreciably from the manufacturer's recommended dosage, the use of this material shall be discontinued unless conditions justify a change in the dosage.

812.04 Composition of Mix. The Engineer will determine the proportions of materials to be used that will produce a workable, dense, concrete conforming to the requirements of Table 812-A for the class of concrete specified. ACI design methods will be used as a guide in determining aggregate proportion. Exceptions to these requirements are as follows:

- (a) The producers of prestressed, precast reinforced concrete items complying with these specifications shall determine mix design proportions for concrete proposed for use. The mix design proportions shall be submitted to the Department's Materials and Research Section for approval prior to use.
- (b) The Contractor shall submit to the Department's Materials and Research Section sources of all materials and mix design proposed for production of Class D concrete prior to any work. Such submission shall be made in sufficient time for preparation of laboratory or field trial mixes and 28-day strength determinations. Field trial mixes shall be made at the concrete supply location and shall consist of 3 yd³ (2.3 m³) (minimum) batches of concrete. All materials, equipment, and labor required to produce the field trial mixes shall be supplied by the Contractor.
- (c) For slip-form paving, concrete shall be Class B with the following restrictions:
 - (1) The composition of the mix shall be such to produce concrete with a slump of 1 to 2 ½" (25 to 65 mm) when tested at the time of placement in accordance with AASHTO T 119.
 - (2) Concrete shall be "central mixed".

(3) Transportation of the concrete shall be only by approved trucks that demonstrate satisfactory loading at the central mix plant and unloading at the Project site.

(4) The design strength shall be 3500 psi (24 MPa) compressive strength at 28 days.

The Engineer will determine the proportions of materials to be used that will produce a workable, dense concrete conforming to the requirements of this Section, Class B as modified above. Should proportions determined by the Engineer vary due to changes in the material originally submitted, no additional compensation will be made. To improve mix workability and consistency, the Contractor may substitute at its expense up to 50% of the Type I portland cement in the Class B mix with ground granulated blast-furnace slag meeting the requirements of AASHTO M 302, Grade 120. The ground slag-portland cement blend will be approved by the Engineer prior to use and may be adjusted at the discretion of the Engineer as field conditions warrant. ACI design methods will be used as a guide in determining aggregate proportions that will produce a workable, plastic concrete having the specified design strength. Should the proportions determined by the Engineer vary due to changes in the materials originally submitted by the Contractor, no additional compensation will be made.

(d) Producers wishing to use fly ash as an additive or a partial replacement for portland cement, shall determine the mix design proportions for the concrete proposed for use. Fly ash use as partial replacement for portland cement in mixtures containing Type I (PM) or IP cement is prohibited.

For mixes containing fly ash, laboratory testing, which is the responsibility of the producer, shall be performed documenting the design's conformance to all requirements and noting that air entrainment is of special concern. Identification of the sources of materials, the mix design proportions, and the results of the laboratory testing of the proposed mix design shall be submitted to the Department's Materials and Research Section for approval prior to use of the design. The producer shall supply appropriate samples of the design materials. The Contractor shall allow for up to five weeks for evaluation by the Department's Materials and Research Section.

When a mix containing fly ash is used, the Contractor shall perform extra sampling and testing of the concrete mixture, as deemed necessary by the Engineer, in order to detect possible harmful variations in the quality of the mix before forms and supports are removed and loading applied. Samples shall be cured in the same ambient temperature as the placed material, in order to more accurately represent the strength of the placed material. Delays due to slow strength gain from a fly ash mix shall not be considered for an extension of time allowed for the completion of the Project.

The requirements of each class of concrete specified are included in the following table:

Table 812-A

Class of Concrete	A	B	C	D
Design Compressive Strength, f_c at 28 days, (Note 1) psi (MPa)	4500 (30)	3000 (20)	2000 (15)	4500 (30)
Design Cement Content, minimum, (Note 2) sacks/yd ³ (sacks/m ²) lb/yd ³ (kg/m ³)	7 1/2 (9.8) 705 (418)	6 (7.8) 564 (334)	4 1/2 (5.9) 423 (251)	7 1/2 (9.8) 705 (418)
Design Water to Cement Ratio, W/C = <u>Weight Cement</u> (Note 3)	0.40	0.45	0.60	0.40
Required Air Content, % (Note 4)	4-7	4-7	4-7	4-7
Required Slump, (Note 5) in (mm)	2-4 (50-100)	2-4 (50-100)	2-4 (50-100)	2-4 (50-100)
Required Admixtures (AASHTO M 194) (Notes 6 & 7)	A, D, F, G	A, D, E, F, G	A, D, E, F, G	A, D, F, G
Notes 8, 9, 10 and 11 refer to all classes of concrete				

Note 1: In addition to meeting the specified f_{2c} design compressive strength, Class D concrete shall achieve f_{cr} , which is the required average compressive strength for f_{2c} . The required average compressive strength, f_{cr} , shall be the minimum compressive strength required for mix approval and shall be in excess of the 4500 psi (30 MPa) design compressive strength, f_{2c} . The degree of excess compressive strength necessary shall depend on expected uniformity of concrete production as per criteria established in the ACI Standard 214. Upon establishment of standard deviation data, the following ACI 318M required average compressive strength values shall govern acceptance of the trial mix proportions:

- f_{cr} = 4900 psi (33.8 MPa) if standard deviation is less than 300 psi (2.1 MPa)
- = 5050 psi (34.8 MPa) if standard deviation is within 300 to 400 psi (2.1 to 2.8 MPa)
- = 5200 psi (35.8 MPa) if standard deviation is within 400 to 500 psi (2.8 to 3.5 MPa)
- = 5400 psi (37.2 MPa) if standard deviation is within 500 to 600 psi (3.5 to 4.1 MPa)

If the standard deviation exceeds 600 psi (4.1 MPa), the concrete production facility shall be unacceptable for Class D concrete production. A probability of not more than one in ten tests falling below the specified compressive strength will be used to compute the required compressive strength. The average 28-day compressive strength of two companion molded 6 by 12" (152 by 305 mm) or 4 by 8" (102 by 203 mm) cylinders prepared from the same batch of concrete shall be considered a "test".

Note 2: For Class D concrete, the average compressive strength and coefficient of variations shall be computed upon the availability of 28-day compressive strength data comprising a minimum of 15 tests from the concrete production plant. Should these determinations indicate an excessive margin of safety, the concrete mix may be modified to produce a lower average compressive strength as approved by the Department's Materials and Research Section, but in no case shall the cement content be reduced to less than 7 sacks/yd³ (658 lb/yd³) [9.2 sacks/m³ (390 kg/m³)]. Should determination indicate a lower average compressive strength or a higher coefficient of variation than anticipated, the quality of the concrete will be evaluated, and mix proportions adjusted as required; however, cement content may not exceed 8 sacks/yd³ (752 lb/yd³) [10.5 sacks/m³ (446 kg/m³)].

Note 3: Water to cement ratio may be expected to vary $\pm 5\%$ depending on varying atmospheric and other related conditions.

Note 4: Water reducing admixtures shall be required in all concrete. The quantity and AASHTO type or combination of AASHTO types of admixtures shall be determined by the Contractor depending on the ambient temperature.

concrete temperature, time of day, thickness of concrete, concrete mix proportions, etc. and the amount and proper type of superplasticizer and/or retarder necessary. The Contractor shall be responsible for the quality of the concrete placed in any weather or atmospheric condition. Failure to achieve a satisfactory product shall be corrected as directed by the Engineer at the Contractor's expense.

Note 5: If a Type F or G admixture is used, the maximum slump shall be 8" (200 mm).

Note 6: The total chloride content of concrete mixtures, when tested in accordance with the requirements of AASHTO T 260, shall not exceed the following:

- a. Prestressed concrete: 0.06%.
- b. Conventionally reinforced concrete in a moist environment and exposed to chloride deicing salts or marine conditions: 0.10%.
- c. Conventionally reinforced concrete in a moist environment or areas with potential moisture condensation but not exposed to chloride: 0.15%.

Limits are expressed as a percentage of the total weight of the portland cement and fly ash in the concrete mix.

Note 7: In calculating the "Water to Cement Ratio" for mixes containing cementitious materials other than portland cement, the weight of the portland cement plus the weight of the cementitious material represents the weight of cement.

Note 8: Consistency of the mix shall be determined by AASHTO T 119. Air content shall be determined by AASHTO T 152, Modified, or AASHTO T 196. Making and curing concrete test specimens shall be in accordance with AASHTO T 23 and it shall be the responsibility of the Contractor to ensure that the seven- and 28-day cylinders are cured for the first 24 to 48 hours in an environment to provide satisfactory moisture and temperature control as per AASHTO T 23.

Note 9: Concrete shall be placed only if the surface evaporation rate, as affected by ambient air temperature, concrete temperature, relative humidity, and wind velocity is less than or equal to 0.15 lb/ft² (0.73 kg/m²) per hour. The Contractor shall determine and document the evaporation rate at the site of the concrete placement, subject to verification by the Engineer. The chart contained in "Plastic Cracking of Concrete" by Delmar Bloem for the National Ready Mixed Concrete Association and published in ACI 305R-89 shall be used to determine the loss of surface moisture for the concrete. The chart may be obtained from the Department's Materials and Research Section.

Note 10: Fixed-form concrete shall meet all requirements of Class B except the 28-day compressive strength shall be 3500 psi (24 MPa).

Note 11: The Contractor has the right to modify their mix design for any class of concrete. The modified mix design will be reviewed by the Engineer prior to approval. The approval will be based upon tests performed by the Contractor and approved by the Engineer.

Note 12: Class D concrete shall have fiber reinforcement added at the rate of 1.5 lb/yd³ (0.90 kg/m³).

812.05 Mix Temperature Limitations. The Contractor shall be responsible for the quality of the concrete placed in any weather or atmospheric conditions.

The concrete shall have a temperature of 70 ± 20 °F (21 ± 11 °C) at the time of placement unless prior permission has been granted to exceed these tolerances; however, concrete for bridge decks shall not exceed 85 °F (30 °C).

In hot weather, the water or aggregate, or both shall be cooled as necessary to maintain the concrete temperature within the specified limits. When the temperature of the plastic concrete reaches 84 °F (29 °C) at the mixing plant, particular attention shall be given to the sprinkling and wetting of the foundation and forms, the maintenance of the coarse aggregate stockpile in a saturated surface-dry condition through use of stockpile sprinklers, the placing and finishing operations, and the prompt starting of the curing operation. When the temperature of the plastic concrete reaches 90 °F (32 °C) at the mixing plant, immediate steps shall be taken to cool the mixing water or aggregate, or both in order to maintain a plastic concrete temperature of 90 °F (32 °C) or less. If such actions are not successful in reducing the concrete temperature, mixing operations shall cease.

812.06 Delivery Restrictions. The time elapsing between the introduction of water to the mix and the placing of the concrete shall be 30 minutes maximum for non-agitating type haul equipment or

60 minutes maximum for agitating type haul equipment. For Class B slip-form concrete, the time elapsing between the introduction of water to the mix and the placing of the concrete shall be 45 minutes maximum for non-agitating type haul equipment of 60 minutes maximum for agitating type haul equipment. Any concrete which has not been placed within these time limits will be rejected for use in the work. These delivery time restrictions may be extended by the Department's Materials and Research Section when an approved water reducing and set retarding admixture is used provided the concrete remains workable for the use intended.

The interval between placing successive loads shall be as directed, however, in no case shall the interval exceed 20 minutes in order that concrete in place shall not have become partially hardened prior to placing successive batches, unless approved in writing by the Engineer.

The method and time of delivery shall be controlled by plant slips signed by the Engineer and issued to the truck driver. The slips shall indicate the name and location of the plant, the size and proportions of the batch, type of admixture used, and the time the mixer is charged. Upon arrival on the job, each slip shall be delivered to the Engineer and will be completed to show the time the concrete is discharged from the truck.

The Contractor shall notify the Department's Project and plant inspectors at least 24 hours prior to the placement of any concrete so that inspection services can be provided.

812.07 Plant and Equipment Requirements

(a) *General Requirements.* All concrete batch plants offered for Department approval shall be equipped for automatic batching and proportioning of all cement, aggregates, and water and for visual observation of automatic insertion of admixtures.

All currently approved concrete batch plants shall retain approved status, unless the approval is rescinded for failure to comply with the batch plant requirements specified herein and the requirements of the current version of AASHTO M 157 for concrete batch plants. In the case where approval is rescinded, reinstatement shall be on the basis of the requirements for automation as specified for approval of plants in the previous paragraph.

The batch plant and all equipment and facilities necessary for performing the work will be inspected and approved by the Engineer as to design, capacity, and condition well in advance of the start of construction. The batch plant shall conform to the requirements of AASHTO M 157, except as modified herein.

A laboratory of 150 ft² (14 m²) minimum shall be provided for the exclusive use of the Engineer at all portland cement concrete facilities. The producer shall furnish all heat, lights, air conditioning, telephone, electric, bottled drinking water, tables, desk, chairs, file cabinets, and all testing equipment or devices to control the production and quality of the concrete. Approved sanitary facilities shall be furnished and maintained.

Inspection of all equipment incidental to the production and transportation of concrete will be performed by the Engineer either on an annual basis or prior to commencement of work on the Contract. If at any time during construction, the equipment is not performing satisfactorily, it shall be repaired prior to re-use. If the concrete plant is to be used for night pours, ample lighting shall be provided to satisfactorily illuminate the aggregate stockpiles along with all areas where the Engineer or the Engineer's representative will be performing testing.

(1) *Bins and Hopper.* The bins shall be in good condition and have adequate separate compartments for fine aggregates and for each required size of coarse aggregate. Each compartment shall be designed to discharge efficiently and freely into the weighing hopper. Means of control shall be provided so that as the quantity desired in the

weighing hopper is being approached, the material may be added slowly and shut off with precision.

The hopper and its appurtenances shall be constructed to eliminate the retention of varying tare materials on any of its parts and operated to ensure a rapid and complete discharge without shaking and jarring the scales.

- (2) *Weighing Equipment.* The scales for weighing material shall be either of the horizontal beam or the springless dial type and shall be the product of an established manufacturer. They shall be of rugged design, constructed to support the hopper or hoppers and with minimum adjustments consistent with the accuracy required. Scale levers shall be of such design, construction, and material to permit frequent handling without damage.

Pivots shall be of steel, sufficiently hardened and tempered to ensure minimum wear under a heavy volume of weighing. They shall be accurately set in substantial mountings to ensure a permanent spacing of the knife edges under all conditions of loading and to prevent them from being loosened by the vibration incident to usage.

Multiple weigh beams on scales to be used for weighing more than one kind of material shall have as many beams as there are different kinds of material to be weighed on the scales. All weigh beams shall be horizontal. The trig loop shall allow movement of the weigh beam above and below the horizontal position for proper operations of the telltale dial as hereinafter specified. The free end of the weigh beam shall be equipped with a suitable device for indicating clearly and accurately the horizontal position of the weigh beam.

Provisions such as a telltale dial shall be made for indicating to the scale operator that the required load in the weighing hopper is being approached. Such a device shall indicate at least the last 200 lb (90 kg) of load.

Poises shall be constructed so they cannot be easily removed from the beam and shall be equipped with a device to hold them firmly in place. Poises and weigh beam shall be made of noncorrosive material and shall be of sufficient hardness to prevent excessive wear.

Graduated dials shall be provided with suitable markers placed outside the glass cover and set closely in front of the dial for use in determining the position of the dial indicator for predetermined loads in the weigh hopper. Provisions shall be made to prevent dirt from collecting in and around the dial mechanism. Means shall be provided for obtaining and maintaining proper alignment between the dial and the part of the scale which transmits the load to the dial. The dial face shall be of a material which is not affected by moisture. The value of the graduations of scales weighing 5000 lb (2250 kg) or less shall not be greater than 5 lb (2.25 kg). The value of the graduations of scales used in weighing over 5000 lb (2250 kg) shall not be greater than 0.1% of the rated capacity of the scales.

Scales shall be so constructed that they are maintained within a maximum tolerance of 0.5% of the net load in the hopper.

Clearance shall be provided between the scale parts and the hopper or bin structure to prevent displacement of or friction between the scales due to vibration or any other cause.

Each scale installation shall be provided with at least 10 standard 50 lb (eleven standard 20 kg, one standard 5 kg, and two standard 1 kg) weights, available for use at the plant at all times for checking scale accuracy. These weights shall be checked for true weight at the Engineer's discretion.

The weights shall be made of high quality cast iron and shall be cast and finished in such a manner that foreign material will not adhere to the surface.

All batching controls shall be positioned so as to allow the operator full view of all scales and admixture dispensers.

The weighing equipment, including dials, weigh beams, bins, and operating levers shall be so arranged that the Department's representatives have a clear and unobstructed view of the weighing operations at all times.

All working parts of the scales, particular knife edges, shall be protected to prevent any material, except windborne material, from falling upon or against them. Suitable windbreaks shall be constructed, when necessary, to prevent variation of the scale mechanism by winds. All working parts of the scales shall be readily accessible for inspection and cleaning.

The individual aggregates, as weighed, shall be within 1% of the required weight, and the total weight of the aggregates shall be within 1% of the required total weight.

All scales shall be checked regularly as determined by the Engineer.

- (3) *Water Supply.* Water shall be measured by volume or by weight. The device for the measurement of water shall be readily adjustable and shall under all operating conditions be accurate within 1% of the quantity of water required for each batch. The device shall be so arranged that the measurements are not affected by variable pressure in the supply line. Measuring tanks shall be equipped with outside taps and valves to provide for calibration unless other means are provided.

- (4) *Admixture Dispensers.* Equipment for dispensing air entrainment or other admixtures shall be of approved design and calibrated prior to being approved. Recalibrations will be made as required by the Engineer.

The flasks and discharge hoses shall be transparent and so arranged that the Engineer has a clear and unobstructed view of the dispensing operation at all times.

- (5) *Automatic Batch Selector.* The automatic batch plant shall be controlled by means of an approved automatic batch selector set to deliver accurately, and in proper sequence, the designated weight of cement and aggregates, and the weight or volume of water and admixtures required for the concrete mixture. The batch selector controls shall be locked or sealed during the operation, and no changes in selector controls or weight settings shall be made except in the presence of the inspector.

For safety reasons, pozzolans, if used, shall be weighed and added after the portland cement has been weighed and added.

Provisions may be included to vary the size of the batch without affecting the basic proportions of the concrete mix being produced.

- (6) *Interlocks.* All batching equipment in automatic plants shall be interlocked so that a new weighing cycle cannot be started until the weigh hopper is empty, the scales are in balance, and the discharge gates and the supply valves included in the system are closed.

- (7) *Mixer.* The mixer shall be of approved design and shall be operated as recommended by the manufacturer. The pickup and throw-over blades shall be replaced or repaired when any part or section is worn 13 (25 mm) or more below the original height of the manufacturer's design. The mixer shall be kept free from accumulations of hardened concrete inside the mixing drum.

The mixer shall be equipped with an approved timing device or, in the case of truck mix concrete, the use of revolution counters or other methods acceptable to the Engineer.

(b) *Specific Requirements.*

(1) *Central Mixed Portland Cement Concrete.*

- a. *Description.* Central mixed portland cement concrete shall consist of portland cement concrete manufactured from previously approved materials, proportioned and mixed in a central mixing plant and transported to the Project in approved vehicles.
- b. *Mixing.* Concrete shall be mixed in a batch mixer, as previously described, for a period of not less than 60 seconds for mixers with capacities of 10 yd³ (7.65 m³) or less. For mixers of greater capacity, the Engineer shall determine the mixing time, based on mixing efficiency. The Engineer reserves the right to adjust the mixing time to any extent necessary to obtain concrete of desired uniformity. Mixing time starts when all the materials, excluding water, are in the mixer. The batch shall be so charged into the drum that some water shall enter in advance of the aggregates and shall continue to flow for a period of not less than five nor more than ten seconds after all aggregates are in the drum. The entire contents shall be removed from the drum before succeeding batches are introduced. Unless otherwise permitted, the maximum batch size shall be the manufacturer's rated capacity for that mixer.
- c. *Moisture Meter.* An automatic electrical moisture meter, equipped with adjustable controls, shall be installed at the Engineer's discretion to measure accurately and continuously the moisture content of the fine aggregate. The meter probe shall be kept cleaned and maintained at all times.

(2) *Truck Mixed Portland Cement Concrete.*

- a. *Description.* Truck mixed portland cement concrete shall be proportioned and dry batched using previously approved materials, with water added for mixing at the plant. Delivery shall be made in approved mixer trucks. Batching and mixing shall be under the supervision of the Engineer.
- b. *Mixer Truck.* Truck mix units shall be designed for both mixing and agitation and shall be equipped with a watertight drum suitably mounted and powered, and fitted with properly designed blades. The mixing unit shall be capable of combining the aggregates into a thoroughly mixed and uniform mass of concrete and of transporting and discharging the concrete without segregation. The pickup and throw-over blades shall be replaced or repaired when any part or section is worn 1" (25 mm) or more below the original height of the manufacturer's design. The inside of the mixer drum shall be kept free from accumulations of hardened concrete.

Water supply equipment for truck mixers shall include a water storage compartment of sufficient capacity to hold mixing water for concrete and wash water required to wash the mixer after depositing concrete in all cases. The equipment shall include an external water gauge calibrated to 1 gal (5 L) intervals and suitable cut-off valves to regulate the quantity of water delivered to the mixer. These cut-off valves must be maintained in first class working order. A truck mixer with a leaky valve will not be permitted on the Project.

The size of the batch which may be charged into the truck mix unit shall not exceed the manufacturer's rated capacity for the unit when operated as a mixer. If the manufacturer's rating is not stamped on each mixing unit, the rated capacity will be determined by the Engineer. Any mixer which shows a variation

in consistency of concrete of more than 1" (25 mm) slump during the discharge of any single batch shall not be permitted to operate until repaired so as to produce concrete of the required uniformity.

- c. *Mixing.* Each batch of concrete mixed in truck units shall be mixed not less than 70 nor more than 100 revolutions of the mixer and at the rate of rotation specified by the manufacturer as the mixing speed. Additional mixing of more than 100 revolutions, if required, shall be done at the rate of rotation specified by the manufacturer as agitation speed. Immediately prior to the addition of water, the drum shall be operated at mixing speed. The mixing period shall be started at the time the cement and water come in contact and there shall be a minimum of 30 revolutions. This operation will be supervised by the Engineer who will indicate on the delivery ticket the time the mix started, the time that the drum is empty, and the time that the entire batch is in place.
 - d. *Inspection Platform.* An inspection platform of suitable dimensions and with reasonable access and safety shall be provided at the plant for the viewing of truck mix concrete by the inspector.
- (c) *Transportation.*
- (1) *Vehicle.* The vehicle in which portland cement concrete is transported shall be an approved type of agitator truck, equipped with a watertight revolving drum, suitably mounted and powered, and fitted with properly designed blades capable of transporting and discharging the concrete without excessive abrasion and segregation.

The agitator unit shall be so constructed as to ensure rapid delivery of the concrete without loss of ingredients and to effect complete discharge of each batch.

Low slump portland cement concrete as used in slip-form paving may also be transported in open trucks designed for that purpose and may be either agitator or nonagitator types, provided that no segregation or loss of water detrimental to the mix, as determined by the Engineer, occurs during transportation and that the concrete delivered to the Project meets the requirements specified.

Both agitator and non-agitator truck types shall be capable of having the dump end elevated so that the concrete will be discharged at sufficient height to permit chuting without segregation.
 - (2) *Size of Batch.* The size of the batch which may be transported in these units shall not exceed the manufacturer's rating for the unit when used as an agitator. If the manufacturer's rating is not stamped on each mixing unit, the rated capacity will be determined by the Engineer.
- (d) *Portland Cement Concrete Made by Volumetric Batching and Continuous Mixing.*
- (1) *Description.* Portland cement concrete made by the volumetric batching and continuous mixing method is permissible for concrete used in bridge deck overlays using latex concrete, headwalls, steps, utility encasement, manhole and inlet bottoms, gutters, curbs, headers, barrier curbs, sidewalks, island pavements, fence and sign post footings, signals, light standard and meter cabinet footings, junction boxes, and small pour items as approved by the Engineer.
 - (2) *Mixing on the Project in a Continuous Mixing Type Truck Mixer.* Continuous mix concrete shall consist of materials accurately proportioned by volumetric measurement from bins on the truck mixer and shall be hydrated and mixed on the truck mixer at the site of the work.

The concrete shall be mixed in an approved type mixing unit that is part of the truck carrying the dry ingredients. The mixing unit shall be an auger type mixer incorporated in the truck's discharge chute or other suitable mixing mechanism approved by the Engineer, shall produce concrete of uniform consistency, and shall discharge the mix without segregation.

A metal plate or plates shall be attached to the truck mixer in a prominent place. The plate or plates shall be plainly marked with the gross volume of the unit in terms of mixed concrete, operating speed, and the cement constant of the mixer in terms of a revolution count required to deliver 94 lb (42.6 kg) of cement, all as rated by the manufacturer.

The truck mixer shall be equipped with a cement bin of sufficient capacity to store and supply the quantity of dry cement required to produce the maximum volume concrete capacity of the truck mixer as rated by the manufacturer. The cement bin shall be free of moisture and contamination at all times.

The truck mixer shall be equipped with aggregate bins of sufficient capacity to store separately the quantities of fine and coarse aggregates required to produce the maximum volume concrete capacity of the truck mixer as rated by the manufacturer. Suitable means, approved by the Engineer, shall be provided to prevent contamination or intermixing of the fine and coarse aggregates during loading and transporting. Aggregate bins shall be covered when there exists a possibility of moisture entering the bins.

The truck mixer shall be equipped with water tanks of sufficient capacity to store the quantity of water required to produce the maximum volume concrete capacity of the truck mixer as rated by the manufacturer and at the slump specified for each concrete section.

If concrete additives are to be used in the mix, suitable means, approved by the Engineer, shall be provided for storing the additives on the truck and incorporating them in the mix. Suitable means shall also be provided on the truck mixer to permit the Engineer to check the rate of flow of the additive into the mix.

The truck mixer shall include a feeder unit mounted under the compartment bins to deliver the ingredients to the mixing unit.

Each bin on the truck shall have an accurately controlled individual gate or feeding mechanism to form an orifice for volumetrically measuring the material drawn from each respective bin compartment. The cement bin feeding mechanism shall be set to discharge continuously and at a uniform rate a given volumetric weight equivalent of cement during the concrete mixing operation. The gates of the aggregate bins shall be calibrated at the various openings to discharge the volumetric weight equivalent of aggregate required for various concrete mixes.

The truck mixer shall be so constructed as to allow the Engineer to check the calibration of the gate openings and meters by means of weight test samples.

The calibration of the gate openings and meters shall be checked and certified either on a semi-annual basis or prior to work on the Contract. A copy of the Certification shall accompany the truck mixer at all times. If, at any time during construction, a piece of equipment is not performing satisfactorily, it shall be repaired satisfactorily prior to reuse.

A $\frac{1}{4}$ yd³ (0.19 m³) box constructed of suitable rigid materials shall be with the machine at all times for calibration purposes.

Each truck mixer shall be equipped with an accurate revolution counter indicator permitting the reading of the volumetric weight equivalent of cement discharged during the concrete mixing operation.

Each truck shall be equipped with fine and coarse aggregate dials to permit accurate adjustments of the gates of the aggregate bins for volumetric proportioning of aggregates.

Each truck mixer shall be equipped with a water meter or gauge to register the discharge rate of water by volume entering the mix.

Each truck mixer shall be equipped with positive automatic means of maintaining the operating speed of the proportioning and mixing operation independent of the drive engine of the truck, and within 8% above or below that established by the manufacturer and noted on the aforementioned metal plate as the speed at which the machine will accurately proportion concrete. Such positive automatic means shall automatically shut down the proportioning and mixing operation when the operating speed varies by more than the above tolerance. A tachometer shall be mounted on the unit to indicate the operating speed.

All indicators, dials, meters, tachometer, and controls shall be in full view and near enough to be accurately read or adjusted by the operator while mixing concrete.

Handling, measuring, and batching of materials shall conform to the applicable requirements of the Section in which the concrete is being placed.

Cement and aggregates shall be proportioned, measured, and batched by a volumetric weight equivalent method. Separate batching equipment and storage bins will not be required and the materials shall be batched in a continuous mixing truck type mixer.

The concrete will be rejected if there is any evidence of improper batching, mixing, excessive segregation, use of excessive mixing water, or if the amount of entrained air is other than as specified.

Tolerances in proportioning the various ingredients are as follows:

Cement (weight percent)	0 to +4
Fine aggregate (weight percent)	±2
Coarse aggregate (weight percent)	±2
Admixtures (weight or volume percent)	±3
Water (weight or volume percent)	±3

Each truck load of ingredients shall be accompanied by a sufficient number of delivery tickets such that the operator may supply one copy of the delivery ticket to the Engineer for each project and for each kind of concrete delivered. The delivery tickets shall show the brand name and type of cement, the calibrated cement constant of the machine in terms of the revolution indicator count, the source of aggregates, and the size of the coarse aggregate. The delivery tickets shall be signed by the mixer operator. The mixer operator shall enter on the tickets the name of the Project, the name of the Contractor, the revolution counter readings indicating the volumetric weight equivalent of cement discharged during that mixing operation, the aggregate dial settings, and the section for which the concrete is delivered. The operator shall sign each completed ticket and furnish one copy to the Engineer.

812.08 Placing and Curing. Placement and curing of portland cement concrete shall conform to the requirements of the Section for which it is being used.

SECTION 813 GRADING REQUIREMENTS MINIMUM AND MAXIMUM PERCENTAGES PASSING

Del. No.	Sieve Size (square openings), millimeters except where noted													
	4" (100)	3 1/2" (90)	3" (75)	2 1/2" (63)	2" (50)	1 1/2" (37.5)	1" (25)	3/4" (19)	1/2" (12.5)	3/8" (9.5)	No.4 (4.75)	No.8 (2.36)	No.16 (1.18)	No.100 (150mm)
1	100	90-100		25-60		0-15		0-5						
2			100	90-100	35-70	0-15		0-5						
3				100	90-100	35-75	0-15		0-5					
57						100	95-100		25-60		0-10	0-5		
67							100	90-100		20-55	0-10	0-5		
8									100	85-100	10-30	0-10	0-5	
10										100	85-100			10-30

	Sieve Size (square openings), millimeters except where noted				
	3/8" (9.5)	No. 4 (4.75)	No. 10 (2.00)	No. 40 (425mm)	No. 200 (75mm)
"RICE"	100	70-100	0-20	0-10	0-5

SECTION 823 HOT-MIX, HOT-LAID BITUMINOUS CONCRETE

823.01 Description. This material consists of hot-mix, hot-laid bituminous concrete bases and surface courses.

MATERIALS.

823.02 Asphalt Cement. The asphalt cement shall be AC 20 with a viscosity grade conforming to the requirements of Section 810. Tank trucks used to deliver asphalt cement shall be equipped with an approved sampling device. The delivery temperature of the material shall not exceed the maximum mixing temperature.

823.03 Fine Aggregate. Fine aggregate is defined as all material passing the No. 8 (2.36 mm) sieve and shall consist of clean, hard, durable crushed stone.

In Job Mix Formula Types B, C, and D, which are defined in Subsections 823.19, 823.20, and 823.21, up to 15% of the fine aggregate may be washed concrete sand, conforming to the requirements of Section 804. If the stability, as determined by the Laboratory Marshall Method in accordance with AASHTO T 245, is less than 1200 lb (5.3 kN), the fine aggregate sand percentage shall be reduced or excluded. All carbonate and serpentine aggregate shall be prohibited in the final roadway wearing surface course on any roadway having a minimum average daily traffic volume (ADT) of 8000 vehicles and a posted speed of 35 mph (60 km/h) or greater.

823.04 Coarse Aggregate. Coarse aggregate shall be all material retained on the No. 8 (2.36 mm) sieve and shall conform to the requirements of Section 805. All carbonate and serpentine aggregate shall be prohibited in the final roadway wearing surface course on any roadway having a minimum average daily traffic volume (ADT) of 8000 vehicles and a posted speed of 35 mph (60 km/h) or greater.

823.05 Antistripping Additive. When specified for use by the Engineer, or when the Tensile Strength Ratio (TSR) is less than 80 as determined in accordance with AASHTO T 283, a heat-stable, antistripping chemical additive conforming to the requirements of Section 829 shall be blended with the asphalt cement in accordance with Subsection 823.16.

823.06 Laboratory. At all batch and dryer drum mixing plants, the Contractor shall provide a building suitable for a field laboratory in which to house and use the equipment necessary to carry on the various tests required, including bituminous extractions and gradations.

The building shall be for the use of the Engineer and inspectors for testing and recording purposes and shall be so located that activities at the plant are plainly visible from one window of the building.

The building shall have a minimum of 600 ft² (55 m²) of floor space and be of acceptable dimensions. It shall be weatherproof and have at least two windows and a door, all equipped with acceptable latches and locks. The building shall be maintained to the satisfaction of the Engineer. Satisfactory lighting, heating, and air conditioning shall be supplied. The air conditioning equipment shall be capable of maintaining the room temperature throughout the laboratory at 77 ° (25 °C) at all times.

The Contractor shall furnish all water, including drinking water, fuel, telephone, heat, and power to conduct all necessary tests. Tables, desks, chairs, and work tables shall be provided and maintained as required. Approved sanitary facilities shall be furnished and maintained.

JP COURTS 3/17
State Project #MC0213000002

If approved, the laboratory may be a part of another building, in which case it shall be completely partitioned off from the remainder of the building.

823.07 Testing Equipment. All production plants shall be equipped with all the necessary equipment from the equipment list supplied by the Department's Materials and Research Section. The Contractor shall ensure that the laboratory contains equipment of approved make and design and shall maintain the equipment to the satisfaction of the Engineer.

Approval of the plant will be contingent upon meeting the requirements of Subsection 823.06 and this Subsection.

823.08 Inspection of Mixing Plant Operations. The Engineer or the Engineer's representative shall have access at all times to all parts of the mixing plant for checking the adequacy of the equipment in use, inspecting the conditions and operation of the plant, verifying the weights or proportions and character of materials, and determining and checking the temperatures being maintained in the preparation of the mixtures.

MIXING PLANTS.

The two types of mixing plants are Batch Type and Continuous Mixing Type.

823.09 Batch Type. Bituminous concrete plants will not be approved unless they are automated.

The automatic batch plant shall be controlled by means of an approved automatic batch selector. The batch selector shall control and deliver, accurately and in proper sequence, the designated weight or volume of bituminous material and aggregates required for the bituminous concrete mixture and shall automatically time the mixing operation. The batch selector controls shall be locked or sealed during the operation, and no changes in selector control or setting shall be made except in the presence of the Engineer's representative.

- (a) *Interlocks.* The plant shall be equipped with interlocking cut-off circuits to interrupt and stop the automatic cycling of the operation at all times when errors in weighing or proportioning occur, or when there is a malfunction of any portion of the control system.
- (b) *Equipment Failure.* If the automatic proportioning devices become inoperative, the plant may be permitted to batch and mix bituminous materials for a period of not more than 48 hours from the time of the breakdown, if approved by the Engineer. Written permission of the Engineer shall be required for a period of operation longer than 48 hours without automatic proportioning.

823.10 Plant and Machinery. The mixing plant used by the Contractor in preparation of the bituminous concrete shall be capable of producing a minimum of 75 tons (68 metric tons) per operating hour and shall comply with the following requirements:

- (a) *Cold Feed.* The plant shall be provided with a separate cold bin or tunnel opening for each size and type of mineral aggregate used in the mix. In addition, each cold bin or tunnel opening shall be equipped with a calibrated gate and mechanical feed to provide a uniform and concurrent flow of aggregates prior to their introduction into the drier.
- (b) *Drier.* The drier shall be a rotating cylinder type suitably designed to heat and dry the aggregates, and shall continually agitate the aggregates during heating. The drier shall be capable of preparing aggregate to the full rated capacity of the paving plant.
- (c) *Burner.* The burner shall be of an approved design and shall be automatically controlled.
- (d) *Sieves.* All plant sieves shall be designed, constructed, and operated so that all aggregates are sieved to their specified sizes and proportions, and shall have a capacity, when operated at normal speed, slightly in excess of the maximum capacity of the mixer.

JP COURTS 3/17

State Project #MC0213000002

- (e) *Bins.* The plant shall include storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Bins shall be arranged to ensure separate and adequate storage of appropriate fractions of the mineral aggregates, and the plant shall be equipped to feed such material into the mixer within $\pm 0.5\%$ of the total batch weight. Separate dry storage shall be provided for filler or hydrated lime when used, and the plant shall be equipped to feed such
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- HOT-MIX, HOT-LAID BITUMINOUS CONCRETE** 823

- material into the mixer within $\pm 0.5\%$ of the total batch weight. Each bin shall be provided with overflow pipes, sized and located to prevent material backing up into other compartments or bins. Each compartment shall be provided with an individual outlet gate that prevents leakage when closed. The gates shall cut the flow off quickly and completely. Bins shall be constructed so that samples can be readily obtained. Bins for continuous mix plants shall be equipped with adequate telltale devices to indicate the position of the aggregates in the bins at the lower quarter points. Each compartment shall be designed to prevent the overflow of material into other bins.
- (f) *Weigh Box or Hopper.* The plants shall have a weigh box of sufficient capacity to hold the maximum amount of the aggregate material for one batch. The weigh box or hopper shall be supported on fulcrums and knife edges, and constructed such that it cannot be easily thrown out of alignment or adjustment. Weighing hoppers must be free from contact with all edges, ends, sides, supporting rods or columns, or with other equipment that will in any way affect their proper functioning. In addition, there must be sufficient clearance between the hopper and supporting devices so that foreign materials will not accumulate. The discharge gate of the weigh box must be positioned to prevent aggregate separation when dumping in the mixer. If necessary, baffles shall be inserted or other means provided to discharge the materials in a blended condition.
- (g) *Aggregate Scales.* Scales for the weighing of aggregates shall be of standard make and design and shall be accurate to 0.5% throughout their range. The scale shall consist of a digital readout connected to a load cell. All digital readouts shall be so located that they will be in plain view of the operator and the Engineer or the Engineer's agent. No weighing of aggregates shall be permitted where vibration from the plant mechanisms or any other source prevents accurate reading of the scale. The value of the gradations of scales weighing over 5000 lb (2250 kg) shall not be greater than 0.1% of the rated capacity of the scale.
- (h) *Bitumen Scales.* The digital scale shall have a capacity of at least 15% in excess of the quantity of bituminous material used in a batch. The controls shall be constructed so that they may be locked at any setting and automatically reset to the reading after the addition of bituminous material to each batch. The readout shall be in full view of the mixer operator and the Engineer and the Engineer's agent and shall be graduated in increments not greater than 1 lb (0.45 kg). The flow of bituminous material shall be automatically controlled. All of the bituminous material required for one batch shall be discharged in not more than 20 seconds after the flow has started. The size and spacing of the spray bar openings shall provide a uniform application of bituminous material the full length of the mixer. The section of the bituminous line between the charging valve and spray bar shall be provided with a valve and outlet for checking the meter when a metering device is substituted for a bituminous material bucket.

The equipment used to measure the bituminous material shall be accurate to $\pm 0.5\%$. The bituminous material bucket shall be a non-tilting type with a loose sheet metal cover. The length of the discharge opening or spray bar shall be adequately heated. The capacity of the bituminous material bucket shall be at least 15% in excess of the weight of bituminous material required in any batch. The plant shall have an adequately heated, quick acting, non-drip, charging valve located directly over the bituminous material bucket.

JP COURTS 3/17

State Project #MC0213000002

- (i) *Test Weights.* The Contractor shall provide and have readily available at least 10 standard 50 lb weights (eleven standard 20 kg, one standard 5 kg, and two standard 1 kg weights), for checking the scales during operations.
- The weighing equipment, in addition to complying with the above requirements, must have adjusting devices which will provide for the readjustment of any part that, being out of adjustment or balance, prevents the scale from functioning properly.
- (j) *Asphalt Control System.* The proper amount of bituminous material in the mix, within the tolerance specified for the job mix, shall be provided by either weighing or metering.
- Heating of asphalt cement shall be by steam coil, hot oil, or other approved methods. Under no circumstances shall a flame from oil or other fuel be permitted to come in direct contact with the heating tanks. The asphalt circulating system shall be sized to give proper and continual circulation of asphalt cement throughout the operating periods.
- (k) *Thermometric Equipment.* An armored thermometer, reading within the ranges used, shall be fixed in the asphalt line at a suitable location near the weigh bucket discharge valve.
- The plant shall also be equipped with an approved dial scale thermometer and an electric pyrometer or other approved thermometric instrument placed at the discharge chute of the drier to automatically register and record the temperature of the heated aggregates. This device shall also be in full view of the burner controller or the head feeder.
- The Engineer reserves the right to judge the efficiency of the above instruments and direct the replacement of the instruments with some approved temperature recording apparatus. Further, the Engineer may require the Contractor to submit daily charts of the recorder's readings.
- (l) *Mixer Unit.* The mixer shall be a heat-jacketed, insulated, batch mixer, of the standard pugmill type, or an approved heat-jacketed, insulated, rotary drum-type mixer. Rotary mixers shall be equipped with a sufficient number of paddles or blades set in position to produce properly mixed batches of any material required under these Specifications. When the clearance in the twin pugmill exceeds 1" (25 mm), either the shortened blades or the worn liners (or both) shall be replaced to reduce the clearance to less than the allowable 1" (25 mm) maximum. The mixer shall be provided with an approved, accurate time lock that will lock the discharge gates until the specified mixing time has elapsed. In no case shall the rated capacity of the mixer specified on the manufacturer's name plate be exceeded. If sufficient mixing and coating is not obtained, the Engineer reserves the right to direct the Contractor to increase the mixing time.
- Deviations in sizes of batches will be permitted to provide for mixing batches 25% below the rated capacity of the mixer. When slag coarse aggregate is used, no increase will be permitted in the size of the batch above the rated capacity of the mixer.
- (m) *Dust Collector.* All plants shall be equipped with an approved dust collector system. Provisions shall be made to waste the collected material or to return it uniformly to the aggregate mixture as directed. All State and local air pollution control regulations and ordinances shall be followed.
- (n) *Safety Requirements.* An adequate and safe stairway to the mixer platform and guarded ladders shall be placed at all points required for accessibility to all plant operations. All gears, pulleys, chains, sprockets, and other dangerous moving parts shall be thoroughly guarded and protected. Ample and unobstructed space shall be provided on the mixing platform. A clear and unobstructed passage shall be maintained at all times in and around the truck loading space, and this space shall be kept free of drippings from the mixing platform. A platform shall be located at the truck loading space to permit easy and safe inspection of the mixture as it is delivered into the trucks. The platform and steps shall have safety handrails. Easy and safe access shall be provided to the location above the mixer where sampling of the aggregate in the bins is to take place. Adequate overhead protection shall be provided where necessary. All other Federal, State, or local safety requirements shall be followed.

JP COURTS 3/17

State Project #MC0213000002

- (o) *Platform Truck Scales.* All plants shall be equipped with platform truck scales to weigh empty and loaded trucks. Truck scales shall be of approved design and kept in good condition. Scales shall be mounted in a concrete foundation that will ensure their remaining level and plumb. Scales shall be mounted to weigh the entire truck. All platform truck scales shall be approved by the appropriate Sealer of Weights and Measures and have seals attached at the beginning of each season or at such other times, as may be deemed necessary. Manufacturer's Certified Scale Checks may be accepted. Split weighing will not be approved.

823.11 Continuous Mixing Type. The use of continuous mixing plants will be permitted for the preparation of hot-mix bituminous concrete, provided such plants conform to the requirements listed below and to the general requirements for all plants.

- (a) *Gradation Control Unit.* The plant shall include a means for accurately proportioning each size of aggregate by either weighing or volumetric measurement. When gradation control is by volume, the plant shall include feeders mounted under the compartment bins. Each bin shall have an accurately controlled individual gate to provide an orifice for volumetrically measuring the material drawn from each bin compartment. The orifice shall be rectangular with one dimension adjustable by a positive mechanical means, and shall be provided with a lock. Indicators shall be provided in each gate to show the gate opening in millimeters.
Mineral filler, if specified, shall be proportioned separately and added to the mix to obtain uniform distribution.
- (b) *Weight Calibration of Bitumen and Aggregate Feed.* The plant shall include a means of calibrating gate openings and meters using weight test samples. The aggregate fed out of the bins through individual orifices shall be bypassed to a suitable test box, confining the material from each compartment in a separate box. The plant shall be equipped to conveniently handle test samples weighing up to 800 lb (360 kg) and to weigh them on accurate scales. Means shall be provided for calibrating the flow of bitumen.
- (c) *Synchronization of Aggregate and Bitumen Feed.* Positive interlocking control between the flow of aggregate from the bins and the flow of bitumen from the meter or other proportioning source shall be provided. This device shall include a mechanical interlock or other positive method of accurate control.
- (d) *Mixer Unit Continuous Method.* The plant shall include a continuous mixer of an approved twin pugmill type, heat-jacketed, and capable of producing a uniform mixture within the permissible variations from the job mix specifications. The angular position of the paddles on the shafts shall be adjustable, and the paddles shall be reversible to retard the flow of the mix. The mixer shall carry a manufacturer's plate giving the net volumetric contents of the mixer at the several heights inscribed on a permanent gauge and the rate of feed of aggregate per minute at plant operating speed.
Unless otherwise required, determination of mixing time shall be by the weights method under the following formula. The weights shall be determined for the job by tests made by the Engineer

$$\text{Mixing Time (s)} = \frac{\text{Pugmill Dead Capacity In Pounds (kg)}}{\text{Pugmill Output in Pounds per Second (kg/s)}}$$

The production capacity of the continuous mix plant shall be not less than 75 tons (70 metric tons) per hour 42 lb/s (19 kg/s).

- (e) *Discharge Hopper.* The discharge end of the pugmill shall be equipped with a hopper, or other approved device for truck loading that will eliminate segregation of the mixed material.

PROCEDURE FOR BATCH OR CONTINUOUS TYPE PLANTS.

823.12 Preparation of Asphalt Cement. All asphalt cement shall be uniformly heated in tanks to a temperature of 250 to 350 °F (120 to 175 °C). Asphalt shall be maintained within these temperature limits.

823.13 Preparation of Mineral Aggregates. Before entering the mixer, the aggregates shall be dried and heated to a temperature of not more than 375 °F (190 °C), except for recycled mixes. Flames used for drying and heating shall be properly adjusted to avoid injury to the aggregate. Immediately after heating, the aggregates shall be screened into separate bins, ready for batching and mixing with asphalt cement.

823.14 Preparation of the Mixture. Each size of hot aggregate and the asphalt cement shall be weighed separately to accurately determine the correct portion of each constituent in the mix. The mixing temperature and tolerance will be given by the Department's Materials and Research Section for the type of material being produced.

The mixture shall consist of coarse aggregate, fine aggregate, mineral filler if required, and asphalt cement. The exact proportions within the limits specified shall be regulated to produce a satisfactory non-boiling mixture with all the particles fully coated.

After the hot fine and coarse aggregates are introduced into the twin pugmill, a minimum dry mix time of 6 seconds shall be required unless otherwise directed by the Engineer. The asphalt cement shall be added in an even sheet the full width of the mixing chamber. After the asphalt cement is added, mixing shall be continued for a minimum of 30 seconds, or until the aggregates are coated and well mixed.

The processed bituminous concrete mixture may be held in an approved storage system in accordance with Subsection 823.17.

823.15 Dryer-Drum Mixers. The plant shall be specifically designed for dryer-drum mixing and shall be capable of satisfactorily heating, drying, and mixing the bituminous mixtures. The aggregate shall enter the drum from the burner-end and shall travel parallel to the flame and the exhaust air stream. The system shall be equipped with automatic burner controls. Heating shall be controlled to prevent damage to the aggregate or the asphalt cement. The temperature of the mixture when discharged from the mixer shall be within the range specified by the Department's Materials and Research Section for the type mix being produced. The rate of flow through the drum shall be controlled to obtain a homogeneous mixture with uniformly-coated particles. In no case shall the quantity of mixture produced exceed the manufacturer's rated capacity.

Each cold feed bin shall have an adjustable gate with an indicator to reference the opening setting. A device shall be installed on each of the aggregate feeders to indicate when the flow of material from the bin is not sufficient to allow accurate proportioning through the feeder gates. These indicators shall be positive in action and shall actuate a clearly visible or audible signal to attract the plant operator's attention, and they shall stop the flow of materials to the drum when the level of material in the bin is too low for accurate proportioning. In addition, for those particular cold bins in which aggregate material tends to either bridge or lump together causing temporary interruptions in feeds, a vibrator or other suitable means shall be provided to ensure uniform flow out of bins so that aggregate material does not bridge or lump. All cold feed bins including mineral filler silos shall be accurate to 0.5% of the total weight delivered by that particular bin or silo. The order of aggregate feed onto the composite cold feed belt shall be from coarse to fine. An independently mounted scalping screen shall be installed if directed by the Engineer.

JP COURTS 3/17

State Project #MC0213000002

Asphalt cement shall be introduced through a continuously registering, cumulative indicating meter by a pump specifically designed for dryer-drum plants. The meter shall be located in the asphalt line to continuously register the asphalt discharge to the mixer and arranged to allow diversion of the discharge through the meter to a container for measurement. The meter shall be equipped with a nonsetback register and shall have an accuracy within 1% by weight of the material actually being measured in any given period of time. The temperature of the asphalt shall be monitored by a thermocouple which shall be calibrated prior to the annual asphalt feed calibration to within 4 °F (2 °C) of a certified mercury thermometer and shall have a digital display on the control panel. The accuracy of the pump and meter shall be verified annually and whenever designated by the Engineer with the Engineer's agent present to document the calibration.

The aggregate feed and the asphalt flow systems shall be interlocked by a blending system that automatically regulates the asphalt flow and immediately corrects for variations in aggregate flow. The system shall provide positive weight measurement of the combined cold aggregate feed by use of a belt scale. The combined cold aggregate feed shall be continuously recorded on a nonsetback register. Feed of material to the belt scale shall be controlled to ensure that the combined aggregate flow is between 50 and 100% of the rated capacity of the scales at normal operation. The plant shall be equipped so that the proportion of each aggregate can be individually varied. The plant shall also be equipped so that the total aggregate rate can be varied without affecting the proportions. The plant shall be equipped with a moisture compensating device in the control panel to automatically correct for the moisture in the aggregate passing over the belt scale. The plant shall be required to use the most recent moisture values obtained to ensure accurate asphalt proportioning. Moisture determinations for the combined aggregate will be made periodically during each day's operation. The plant shall also be equipped with a device in the control panel to automatically correct for the specific gravity of the asphalt.

Safe, adequate, and convenient facilities shall be provided for obtaining representative asphalt and aggregate samples. The plant shall be equipped with a sampling device capable of providing a sample of sufficient size from the full width of the combined aggregate cold feed flow. The sampling device shall be designed so that samples may be taken while the plant is operating at normal production rates. Safe, adequate, and convenient facilities shall be provided for calibrating the asphalt flow and the aggregate flow. The manufacturer's recommendations shall be followed for calibration. To calibrate the aggregate flow system, means shall be provided to permit a positive and uniform diversion of the aggregate in sufficient quantity to accurately check the weight of aggregate per period of time. To calibrate the asphalt metering system for proper proportioning, an asphalt distributor or other equipment approved by the Engineer shall be made available so that accurate tare, gross, and net weights may be obtained for the diverted asphalt discharge. The rate of flow of the total aggregate and asphalt flow shall not vary by more than 2.0% by weight from the required quantity of each.

The dryer-drum mixer shall be capable of simultaneously heating and mixing the introduced aggregate and asphalt to produce an acceptable, thoroughly coated mix meeting the required temperature and mix designs. Pyrometers or other thermometric instruments shall be located at the discharge chute of the dryer-drum mixer to automatically register the temperature of the mix.

823 HOT-MIX, HOT-LAID BITUMINOUS CONCRETE

Prior to mixing of hot-mix bituminous concrete in drum mix plants, the gradation of all stockpiled aggregate material shall be checked for grading requirements conforming to Section 813 and shall be approved prior to use. Aggregate from the approved stockpiles shall be selected based on a percentage of the stockpile sizes to meet the appropriate job mix formula gradation according to Subsections 823.20, 823.23, and 823.24. Samples from the cold feed conveyor shall be taken to ensure that the proper gradation requirements are being met prior to the addition of asphalt for production of hot-mix.

JP COURTS 3/17

State Project #MC0213000002

823.16 Antistripping Additive Blending - All Plants. Blending of the additive and asphalt cement shall be accomplished at the bituminous concrete production plant during the production of bituminous material, through the use of an approved in-line metering and blending system. The holding tank shall be thermostatically controlled for heat and shall have a recirculating line for uniform heat control. The additive temperature shall be maintained at a uniform mix temperature at least 24 hours prior to production to ensure uniform additive viscosity. There shall be a diverter valve in the recirculating line from the pump for calibration purposes, which shall deliver a full stream from the additive pump at a height equivalent to the addition input to the main asphalt line. Additive pumps shall be calibrated on a daily basis or whenever deemed necessary by the Engineer. The calibration shall be done by plant personnel and witnessed by a representative of the Department's Materials and Research Section.

823.17 Storage Systems - All Plants. The system shall be capable of conveying the hot-mixture from the plant to the storage bins and storing the hot-mixture without a reduction in temperature and with no segregation of the mix or oxidation of the asphalt. The mixture, as delivered for the work, shall comply with all specified quality requirements.

The conveyor system may be either a continuous or skip bucket type. The continuous type shall be enclosed and heated to effectively control the mix temperature. The skip bucket type must be large enough to transport and mass dump an entire batch into the bins.

The storage bins shall be designed to prevent segregation of the mix during discharge from the conveyor into the bins. The bin discharge gates shall be designed to prevent segregation of the hotmixture while loading into trucks. Approval for the use of storage bins may be withdrawn when excessive heat gain or loss, uneven heating, segregation of the aggregate, or migration or oxidation of the asphalt occurs due to the operation or use of storage bins. Mixtures may be retained in heated storage bins for 12 hours, provided that material and mixture qualities are maintained.

MIXTURE REQUIREMENTS.

823.18 Applicable Testing Methods. The following standards shall be used to test the qualities of the mixture.

AASHTO T 164	Method A, Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
AASHTO T 166	Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens
AASHTO T 209	Maximum Specific Gravity of Bituminous Paving Mixtures
AASHTO T 245	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
AASHTO T 269	Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
AASHTO T 283	Resistance of Compacted Bituminous Mixture to Moisture Induced Damage
AASHTO T 287	Asphalt Cement Content of Asphalt Concrete Mixtures by the Nuclear Method

Samples of the actual mixture in use will be taken as many times daily as determined by the Engineer. The mixture must be maintained uniform throughout the Project within the above tolerances. Should the mix produced not meet the above requirements or the Contract performance needs, changes in the mix design or mixing procedure shall be made immediately in a manner approved by the Engineer.

If an additional source of supply for materials is submitted and approved, the job mix formula shall be readjusted as necessary by the Contractor and submitted to the Engineer. All job mix formulas submitted and found unacceptable shall be readjusted to the satisfaction of the Engineer.

JP COURTS 3/17
State Project #MC0213000002

823.19 Job Mix Formula Types A, B, C, D, and E. The general composition limits prescribed in this Section are master ranges of tolerance to govern mixtures made from all raw materials conforming to the requirements of Sections 804 and 805. The composition limits are maximum and minimum in all cases. Closer control may be required for job materials used for specific projects according to the job mix formula. No work shall be started on the Contract, and no mixture will be accepted for the work, until the proposed job mix formula has been approved. The Contractor shall submit a written proposal indicating the single definite percentage for each sieve fraction of aggregate and for the asphalt that the Contractor chooses as the fixed percentage for each component in the mix. The proposal shall also indicate the temperature at which the Contractor shall furnish the mixture at the plant. The approval of the job mix formula shall bind the Contractor to furnish paving mixtures that not only meet the master ranges, but also meet the exact formula set for the Project, within the allowable tolerances.

HOT-MIX, HOT-LAID BITUMINOUS CONCRETE

823

823.20 Gradation for Job Mix Formula Types A, B, C, D, and E.

Sieve Size	Type A (%)	Type B (%)	Type C (%)	Types D & E (%)	Job Mix Tolerance (%)
2½" (63 mm)	100	---	---	---	±7
2" (60 mm)	90-100	---	---	---	±7
1½" (37.5 mm)	60-90	---	---	---	±7
1¼" (31.5 mm)	---	100	---	---	±7
1" (25.0 mm)	40-75	95-100	---	---	±7
¾" (19.0 mm)	---	75-95	---	---	±7
½" (9.5 mm)	30-65	50-85	100	---	±7
⅜" (9.5 mm)	---	45-70	85-100	100	±7
#4 (4.75 mm)	20-45	30-50	50-75	80-100	±7
#8 (2.36 mm)	---	22-38	33-59	70-90	±4
#30 (600 µm)	---	9-23	14-32	30-55	±4
#50 (300 µm)	---	6-18	7-26	15-40	±4
#200 (75 µm)	2-10	3-10	3-10	5-15	±2
A.C., %	2.0-4.0	3.5-5.5	4.5-6.5	6.0-8.5	±0.4
Temp. °F	225-275	275-325	275-325	275-325	±20°F
Temp. °C	(107-135)	(135-163)	(135-163)	(135-163)	±11

The percentages for aggregates are based on the total weight of aggregate. The percentages for asphalt cement are based on the total weight of the mix.

Washed gradations of final products shall be used to determine the amount of No. 200 (75 µm) material. The washed dust to effective asphalt ratio shall be between 0.6 and 1.2 for the final mixture.

JP COURTS 3/17
State Project #MC0213000002

823.21 Marshall Properties for Job Mix Formula Types A, B, C, D, and E.

Specific Requirements	Mix Type			
	A	B	C	D & E
Air Voids, % (Compacted Specimen)	---	3.0-5.0	3.0-5.0	3.0-5.0
Stability, (minimum)	750lb (3.4 kN)	1000 lb (5.3 kN)	1000 lb (5.3 kN)	1000 lb (5.3 kN)
Flow, 0.01 in (0.25 mm)	8.0-20.0	8.0-20.0	8.0-20.0	8.0-20.0
Voids in Mineral Aggregate (VMA)*, % (minimum)	11.5	13.0	16.0	18.0

* The VMA shall be calculated from the combined bulk specific gravities of the aggregate and the actual asphalt cement content determined by the laboratory testing.

823.22 General Uses for Job Mix Formula Types A, B, C, D, and E.

- Type A - Open plant mix base course
- Type B - Dense graded base and binder course
- Type C - Dense graded surface course
- Type D - Fine, dense graded surface course
- Type E - Curb mix

823.23 Bituminous Concrete Base Course Mixture. Mix and gradation requirements for the base course mixture shall be as follows:

- (a) Mix Requirements:
 - Asphalt Content 3.0 - 4.5% of total mixture weight
 - Air Voids 3.0 - 6.0
 - Stability 1000 lb. (4.5 kN), minimum
 - Flow- 8.0 - 18.0 (0.01 in) [0.25 mm]
- (b) Gradation Requirements:

<i>Sieve Size</i>	<i>Percent Passing</i>
1 ½" (37.5 mm)	100
¾" (19.0 mm)	75 - 100
⅜" (9.5 mm)	48 - 80
No. 8 (2.36 mm)	20 - 48
No. 30 (600 µm)	10 - 30
No. 50 (300 µm)	7 - 25
No. 200 (75 µm)	3 - 10

During production of the base course mixture, the gradation of the aggregates may vary between the specified limits, but such variations shall be gradual. Sudden variation from coarse to fine and fine to coarse on any sieve will not be tolerated.

JP COURTS 3/17
State Project #MC0213000002

823.24 Plant Mix Open-Graded Wearing Surface Mixture. The open-graded wearing surface shall be composed of a mixture of approved aggregate and asphalt cement. Gradation shall be as follows:

<i>Sieve Size</i>	<i>Master Range Percent Passing</i>	<i>Tolerance from Job Mix (±)</i>
½" (12.5 mm)	100	0
3/8" (9.5 mm)	88 - 98	3
No. 4 (4.75 mm)	25 - 42	5
No. 8 (2.36 mm)	5 - 15	3
No. 200 (75 µm)	2 - 5	1.5

Asphalt cement shall be from 6.0 to 8.0% of the total mixture weight (to be determined by Laboratory Tests). The temperature of the asphalt cement shall not be greater than 310 ± 10 °F (154 ± 6 °C) when introduced into the mixer.

A heat-stable, antistripping additive conforming to the requirements of Subsection 823.05 shall be added to all asphalt cement used for open-graded surface course. The amount of the additive used shall be between 0.25 and 1.0% by weight of the asphalt cement as recommended by the additive manufacturer and approved by the Departments Materials and Research Section.

The additive shall be thoroughly and uniformly blended with the asphalt cement at the hot-mix production plant in accordance with Subsection 823.16.

The target temperature (± 10 °F) [± 6 °C] of the mix leaving the mixer shall be established by the Department on the basis of laboratory tests. A target temperature of 240 ± 10 °F (116 ± 6 °C) is typical.

Aggregate shall conform to the requirements of Section 805, except slag will not be permitted. The use of limestone or serpentine aggregate or natural sand, washed or unwashed, is prohibited. The use of washed concrete sand is also prohibited.